

Reflectoscope

UM-771

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REFLECTOSCOPE DISPLAY UNIT UM-771/775

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TYPE UM775 ULTRASONIC REFLECTOSCOPE



TYPE UM771 ULTRASONIC REFLECTOSCOPE

Figure 1-1

CHAPTER 1

INTRODUCTION

1.1 PURPOSE

The UM-771 and UM-775 Reflectoscope units, as illustrated in Figure 1-1, provide an ultrasonic nondestructive testing instrument which has been human engineered and designed for use as a bench or laboratory Reflectoscope for ultrasonic testing applications.

1.2 SCOPE

This publication contains a general description, preparation for use, operation, electrical description, and maintenance on the UM-771 and UM-775 Reflectoscope. Supplemental data such as Glossary, Principles of Reflectoscope Operation, Parts List, and Schematic are included in the appendices at the rear of the Manual.

1.3 INTRODUCTION AND GENERAL EQUIPMENT DESCRIPTION

1.3.1 The UM-771 and UM-775 Reflectoscopes are instruments used for ultrasonic nondestructive testing of materials. Ultrasonic inspection is generally applied to three classes of material inspection:

- a. Locating internal discontinuities or inhomogeneities in materials.
- b. Determining the differences in structure and physical properties.
- c. Measuring the thickness of material.

The UM Reflectoscopes are visually interpreted ultrasonic instruments for both contact and immersion testing with either single or dual search unit techniques. Alarm and recording systems for ultrasonic inspection may be added for monitoring tests at production speeds.

1.3.2 General Description of the Equipment

Cabinet and chassis description: The UM-771 and UM-775 Reflectoscope cabinets are illustrated in Figure 1-1.

Two different types of chassis frames are available which will fit into two different sizes of wraparound aluminum covers.

The CRT, Deflection Amplifier, Low Voltage ~~and~~ High Voltage Power Supplies are contained in the UM-771 and UM-775 Display Chassis. To complete the instrument, Timer and Pulser/Receiver Plug-in units are used in the UM-775 Reflectoscope. This arrangement constitutes a "basic" ultrasonic test instrument.

The UM-775 Reflectoscope is intended for use where interpretation is visual and no accessory functions are required, or planned for the future. Small size and weight are desirable features of the UM-775 Reflectoscope.

The UM-771 Reflectoscope is intended for use where more versatility in ultrasonic testing is required. Provision is made within the chassis for plugging in one accessory unit. The particular accessory unit may be selected to complement the Display/Timer and Pulser/Receiver units to perform specific ultrasonic tests such as Transigate for flaw detection or thickness readout for thickness measurement. The performance of the UM-771 and UM-775 are identical in the basic instrument version. The same quality and accuracy of tests will be obtained by using either the UM-771 or the UM-775 Reflectoscope. Various plug-in units of the UM-775 Reflectoscope are shown in Figure 1-2.

1.3.2.1 Display Circuitry

The display circuitry in the UM-771/775 Reflectoscope contains separate assemblies which are easily removed from the Reflectoscope chassis. The assemblies are:

- a. Transformer chassis assembly.
- b. Rear Panel and L. V. Power Supply Assembly (This includes heat sink, connectors, rear panel, wire harness, and Low Voltage P.C. Board).
- c. High Voltage and Plug-in Board Assembly (This includes wire harness to CRT and High Voltage Power Supply).
- d. Deflection Plug-in Board Assembly (This includes wire harness and Deflection P.C. Board assembly).
- e. Interconnect Board Assembly (This includes connector, wire harness, and Interconnect Board sub-assembly).



UM-775 Reflectoscope CRT Display with Timer
and Pulser/Receiver Plug-in Units Extended
(Timer inner panel removed)

Figure 1-2

1.3.2.2 The Cathode Ray Tube

The cathode ray tube is a five-inch diameter, flat-faced type with a 3 inch x 4 inch display area. Graticule scribed lines are permanently etched on the inside of the CRT. All operating controls for the display are located on the front panel, and functionally grouped for ease of operation.

1.4 SPECIFICATIONS

1.4.1 Mechanical Specifications

1.4.1.1 The instrument frame is made up of self-supporting clear anodized aluminum members and is covered with removable painted aluminum covers.

1.4.1.2 A carrying case handle is used for easier instrument portability.

1.4.1.3 Foot-knobs at the four corners, bottom, and rear of the instrument permits positioning in either upright or horizontal positions.

1.4.1.4 Fuses, and power connections, are located in the recessed instrument back. ON/OFF power instrument indicator light and front controls are located in the front recessed instrument front. Ventilation fan provides filtered, pressurized forced air ventilation, assuring proper operating temperature for all components in the Display, the Timer, Pulser/Receiver and the Accessory Unit.

1.4.1.5 A rectangular, 3 x 4 inch high-intensity viewing screen has scribed graticule on the inside face of the cathode ray tube. Since the graticule reference lines are etched on the inside face of the CRT tube glass, parallax waveform errors are kept at a minimum. An outline of the actual size CRT screen is illustrated in Figure 1-3.

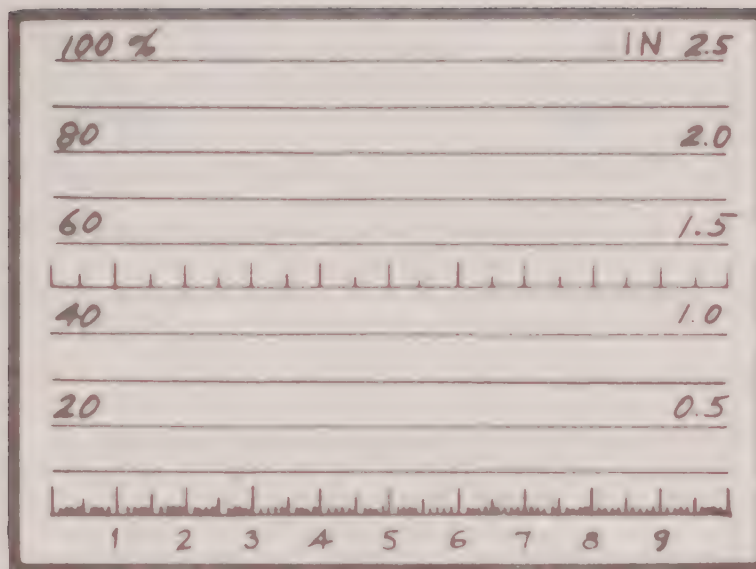


Figure 1-3 UM-771/775 Reflectoscope CRT Screen (Actual Size)

1.4.1.6 Weight of the UM-771/775 Reflectoscope

UM-771 Reflectoscope

CRT Display	30 lbs
Timer Plug-in Unit	2.5 lbs
Pulser/Receiver Plug-in Unit	2.5 lbs
Accessory Plug-in Unit	3 lbs
Total Weight	38 lbs

UM-775 Reflectoscope

CRT Display	26 lbs
Timer Plug-in Unit	2.5 lbs
Pulser/Receiver Plug-in Unit	2.5 lbs
Total Weight	31 lbs

1.4.1.7 Size of the UM-771 and UM-775 Reflectoscope CRT Display

<u>UM-771 Reflectoscope</u>	<u>UM-775 Reflectoscope</u>
Height 7-3/8 inches	Height 7-3/8 inches
Width 19-3/4 inches	Width 13-1/8 inches
Length 20-1/4 inches	Length 20-1/4 inches

1.4.1.8 Plug-in Modules

- a. The Pulser/Receiver plug-in unit slides in and out on plastic-aluminum channel frame members and is locked in position by a knob control cam.
- b. The Accessory Plug-in unit slides in and out on plastic-aluminum channel frame members and is locked in position by a knob control cam.
- c. The Timer plug-in unit slides in and out on plastic-aluminum channel frame members and is locked in position by a knob control cam.

1.4.2 Electrical Specifications

UM-771/775 Reflectoscope CRT Display

1.4.2.1 Power Requirements

- a. UM-771 Reflectoscope (with plug-in units) 115V plus or minus 15V or 230 plus or minus 30V, single phase 50 to 60 cycles, 132 watts.
- b. UM-775 Reflectoscope (with plug-in unit) 115V plus or minus 15V or 230 plus or minus 30V, single phase 50 to 60 cycles, 132 watts.

1.4.2.2 Operating Temperature Range ---- -28.9°C to 71.91°C (-20°F to 160°F).

- a. Transformer chassis assembly - provides AC input power supply voltages. Also provides CRT-AC filament voltage.

- b. Rear Panel and L.V. Power Supply Assembly - this circuit furnishes the voltages needed to operate high voltage supply, deflection amplifiers, interconnect board, cathode ray tube, the Pulser/Receiver and Timer.
- c. High Voltage and Plug-in Board Assembly - this circuit supplies high voltage to the CRT. This board also contains the unblanking amplifier.
- d. Deflection Plug-in Board Assembly - contains five major circuits:
 1. Horizontal deflection amplifier.
 2. Vertical selection circuit (This circuit is for time sharing the vertical information).
 3. Vertical deflection amplifier.
 4. Vertical mixing network.
 5. CRT trace alignment control.
- e. Interconnect Board Assembly - the function of this board is a terminal device through which five of the major assembly interconnections are made:
 1. Low Voltage Power Supply.
 2. High Voltage Power Supply.
 3. Deflection Amplifier and Timer.
 4. Pulser/Receiver.
 5. Accessory.
- f. Cathode Ray Tube - the vertical CRT indications of the initial pulse delivered to the search unit and all echo signals received by the search unit are displayed on the CRT horizontal base line.

1.5

ACCESSORIES

Addition of any standard UM accessory without modification is possible by merely plugging into accessory space. Such standard accessories are listed below.

- a. Pulser/Receivers and Search Units.
- b. Special Function Cabinet.
- c. Front Plug-in Units.
- d. Rear Plug-in Units.
- e. Timer-A.

1.5.1

Pulser/Receivers and Search Units

Sperry Pulser/Receiver plug-in modules are available in frequencies from 200KHz to 50 MHz (partial list in Table 1-2) for operation with UM-771/775 Reflectoscope Display Units (see Figure 1-4). They contain the circuitry for generation and transmission of high frequency pulses to the transducer, for receiving, amplifying, and detecting the high frequency echo or return pulses from the test specimen, and for limiting and transferring the detected video pulses to the time control unit and thence to the Reflectoscope Display and any accessory equipment in use.

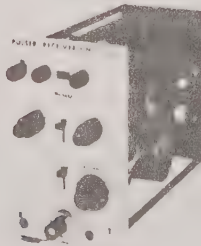


Figure 1-4 A Typical Pulser/Receiver 10S db

TABLE 1-1

UM PULSER/RECEIVER TYPES

Asst'y No.	Type	Frequencies	Description
50E534	1N	0.2, 0.4, 1.0 MHz	Similar to 5N, different frequency range.
50E528	2.25N	0.4, 1.0, 2.25 MHz	Similar to 5N, different frequency range.
50E524	5N	1.0, 2.25, 5.0 MHz	General purpose Pulser, Receiver.
50E597	NH	1.0, 2.25, 5.0 MHz	5N modified to handle 10 MHz.
50E504	N-RF	1.0, 2.25, 5.0 MHz	5N With RF Display.
50E504	5N-Weld	1.0, 2.25, 5.0 MHz	Weld Inspection.
50E533	10N	2.25, 5.0, 10.0 MHz	General Purpose.
50D556	10S	1.0, 2.25, 5.0, 10.0 MHz	General Purpose Solid State.
50D525	10S db	1.0, 2.25, 5.0, 10.0 MHz	General Purpose DB controls Solid State.
50D558	10W	500 KHz to 10 MHz	Solid State
50D571	10W DAC	500 KHz to 10 MHz	Solid State with Distance Amplitude Correction
50E577	50W	10.0 to 50 MHz	High Resolution Broadband P.P. for thickness measurement.

1.5.1.1 HFN Pulser/Receiver Plug-in
(See Figure 1-5).

Flexible design permits optimum performance at selected frequencies by use of a separate plug-in printed circuit board for each frequency. High sensitivity and high resolution are obtained through the use of these pre-tuned plug-in boards.

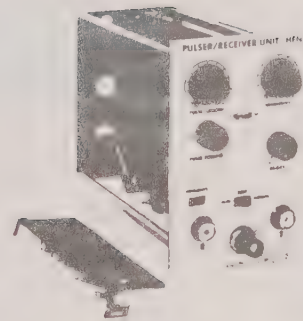


Figure 1-5 Pulser/
Receiver HFN Series

Table 1-3 contains information on types, frequencies and characteristics of the various plug-in UM Pulser/Receiver HFN Series.

TABLE 1-2
HFN Pulser/Receiver Plug-in

Ass'y No.	Frequencies	Description
50E527	HFN Pulser/Receiver (Less Freq. Boards)	Plug-in Frequency Boards are used for various High Resolution and Sensitivity requirements
50K4187	HFN Bd. 200 KHz	
50K4188	HFN Bd. 400 KHz	
50K4256	HFN Bd. 1.0 MHz	
50K4257	HFN Bd. 2.25 MHz	
50K4249	HFN Bd. 5.0 MHz	
50B954	HFN Bd. 10.0 MHz	
50B955	HFN Bd. 15.0 MHz	
50K4493	HFN Bd. 20.0 MHz	
50B956	HFN Bd. 25.0 MHz	
50K3923	HFN Bd. 45.0 MHz	

1.5.1.2 Search Units

A Search Unit is a piezoelectric transducer specifically designed for ultrasonic inspection. Automation Industries manufactures a complete line of search units including single and dual element contact, angle beam, immersion and water delay line combinations.

Typical crystal materials used in the construction of these devices are lithium sulphate, barium titanate, lead zirconate titanate and quartz. These materials are used both singular or in combination in order to obtain the optimum results from their respective piezoelectric properties.

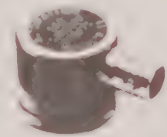


Figure 1-6 Illustrates one of the many Search Units

Immersion search units are available in flat and focused configurations. Contact testing search units are offered with flat elements for direct application to the material under test. Various adaptors such as abrasion resistant wear faces, liquid and solid delay lines as well as beam refracting wedges for angle beam inspection are available. A wide variety of element sizes, connector designs and case styles afford an excellent selection for all inspection requirements.

1.5.2 Type UM-710 Special Function Cabinet

1.5.2.1 The Type UM-710 Special Function Cabinet is designed to house plug-in accessory components which will increase the versatility and range of applications of the basic UM Reflectoscopes by providing a wide variety of special functions for recording, gating, controlling, counting, and alarm purposes.

1.5.2.2 The Special Function Cabinet is designed to mount either beneath or above Type UM Reflectoscopes. Additional cabinets may be added as required to increase special function capabilities by providing for the use of more plug-in components. The Special Function Cabinet is the same size as the Type UM Reflectoscope.

1.5.2.3 Many different configurations are possible when the Special Function Cabinet is combined with a Type UM Reflectoscope. Gating units may be combined with recording units, additional Pulser/Receiver units may be combined with gating units to greatly increase the number of channels available.

1.5.3 Front Plug-in Units for the Reflectoscope UM-771 and/or Special Function Cabinet UM-710.

- a. The Fast Transigate Ass'y No. 50C753. The Fast Transigate provides flexibility in establishing ultrasonic inspection systems for semi-automatic or automatic detection of flaws in materials at production speeds. This is accomplished by setting up specific, controllable gated areas or zones within a test piece. Signals appearing within these gates generate visual and/or aural alarms.
- b. Dual Fast Transigate Ass'y No. 50E621. The Dual Fast Transigate is similar to the Fast Transigate Assembly except that this unit has Dual Fast Transigate characteristics.
- c. TR Thickness Readout Module Ass'y No. 50E568. This unit is designed to provide an indication of thickness, using signals derived from any Pulser/Receiver unit. A feature of this module is the ability to provide an expanded scale readout, and an alarm at any selectable thickness. As little as 10% of full scale thickness can be presented, i.e., a 1" thickness could be set to read .95" at one end of the scale and 1.05" at the other end.
- d. Attenuometer Ass'y No. 50E601. Measures attenuation of ultrasound energy in materials and provides direct meter readout in dB/inch through four ranges: 0-2, 0-5, 0-10, and 0-20. Plugs into UM Reflectoscope.
- e. Type UM DAC - Distance Amplitude Correction - Ass'y No. 50E551. Capable of correcting signal response in "near field" zone and "far field" zone, with simultaneous display of both video signals and DAC curve for easy set-up.
- f. Type UM Transigraph Control for shaded tone recording, Ass'y No. 50E543. Transigraph system plugs into UM-710 Special Function Cabinet and requires 50C753 Transigate and 50A3159 STF Recording Amplifier.

- . Graphigate for shaded tone recording, Ass'y No. 50E589. The Graphigate plugs into the extra compartment of the UM 771 Reflectoscope and is used with the 50K4755 Type "S" single panel Recording Amplifiers for shaded X-Y facsimile recordings.
- . SW Channel Selector, Ass'y No. 50D288. Display selector for multi-channel System.

1.5.4 Rear Plug-in Units for the UM-771 Reflectoscope and the Special Function Cabinet UM-710.

- . Type "W" Transfer Chassis, Ass'y No. 50D271. Required for multi-channel systems with one or two Pulser/Receivers, the "W" transfer chassis relays information between the Reflectoscope and other modules. It is a double panel module which plugs into the rear of the UM710 Special Function Cabinet.
- . Type "R" Relay Chassis, Ass'y No. 50C434. The "R" Relay Chassis is a double panel plug-in module designed to fit into the rear of the UM710 Special Function Cabinet and to operate with one Pulser/Receiver. It accepts two front panel special function modules and provides outputs for driving external solenoids and alarms and for feeding signal information to external pre-amplifiers for recorders.
- . Type "RM" Relay Chassis, Ass'y No. 50C563. The "RM" Relay Chassis provides the same outputs as the "R" Chassis, but is used in multi-channel operation with more than one Pulser/Receiver.
- . Type "S" Recording Amplifier, Ass'y No. 50E530. A double panel plug-in designed to fit into a rear compartment of the UM710 Special Function Cabinet, the Type "S" Recording Amplifier operates with a single channel system (one Pulser/Receiver). The "S" Recording Amplifier accepts two front panel special function modules and provides outputs from information received from associated circuits.

The Type "S" yields outputs the same as those of the "R" Relay Chassis, and also provides outputs for direct operation of strip chart or vet facsimile (Alfax) recorders with no other amplifiers required.

- e. Type "SM" Recording Amplifier, Ass'y No. 50B969. The "SM" Recording Amplifier is used for multi-channel operation with more than one Pulser/Receiver where outputs similar to the type "S" Recording Amplifiers are required.
- f. Type "STF" Recording Amplifier, Ass'y No. 50A3159. The Type "STF" Recording Amplifier is a double panel rear compartment plug-in for wet type shaded tones x-y facsimile recordings. It is designed to accept one Transigate module and one Transigraph module.
- g. Type "RS" Recording Amplifier, Ass'y No. 50K4745. A double panel rear plug-in, this module is designed to operate with one Pulser/Receiver. It accepts two front panel Special Function modules and provides outputs received from associated circuits for driving external solenoids and alarms and to feed signals into strip chart and wet or dry x-y facsimile recorders (black and white, no shaded tones).
- h. Type "RSM" Recording Amplifier, Ass'y No. 50K4756. This double panel plug-in provides the same outputs as the Type "RS" but is used in multi-channel operation with more than one Pulser/Receiver.
- i. Type "R-STF" Recording Amplifier, Ass'y No. 50K4741. The "R-STF" Recording Amplifier is a double panel rear plug-in used for shaded tones x-y wet or dry facsimile recordings. It accepts one Transigraph module and one Transigate module.
- j. Type "S" Single Panel Recording Amplifier, Ass'y No. 50K4654. This rear plug-in module fits into the UM-771 Reflectoscope and is used with a Transigate module for wet or dry x-y facsimile recordings (black and white, no shaded tones).
- k. Type "S" Single Panel Recording Amplifier, Ass'y No. 50K4755. The Type "S" Single Panel Recording Amplifier plugs into the rear of the UM-771 Reflectoscope for wet or dry shaded tone x-y facsimile recordings when used with Style 50E589 Graphigate. When used with a Transigate module, wet or dry black and white x-y recordings may be made.

1.5.5 **Timer-A.** **Timer** Plug-in Unit is used with the UM-771 and UM-775 Reflectoscope. The Timer Unit plugs into the lower left side of the Reflectoscope.

1.5.5.1 Timer-A Specification

- a. Sweep range - continues from 0 to 500 inches of material.
- b. Material - adjusts sweep range calibration for various materials from Teflon thru aluminum.
- c. Sweep delay - continues control from 0 to 200 inches in steel.
- d. Rate (Pulse) - 100 to 2,000 Hz (pps) a lockout feature is provided to step down the repetition rate for long sweep delay and sweep times, thus allowing maximum brightness for all testing conditions.
- e. Mode-Longitudinal or Shear wave, sweep calibration. Shear wave calibrated in steel (1.8:1).
- f. Sweep linearity $\pm 1\%$.
- g. Alternate trace - provides alternate display (DAC).

CHAPTER 2

PREPARATION FOR USE

2.1 GENERAL

This chapter contains unpacking, handling, installation and initial instrument check out. The following steps should be followed to assure optimum operating conditions.

2.2 UNPACKING AND HANDLING

2.2.1 The UM-771/775 Reflectoscope is secured in a shock absorbent molded rubberized hair nest material and packed into a cardboard box for shipment. Also packed in the nest is an accessory kit.

..... To Remove Reflectoscope, Proceed as Follows:

- a. Open the cardboard shipping container by cutting the tape which seals the two half flaps together to the sides of the container.
- b. Lift off the top cover of the rubberized hair nest. The Reflectoscope, the accessory kit, and the instruction manual should be visible.
- c. Remove the accessory kit and instruction manual. It is suggested that the Instruction Manual be read several times by the novice Reflectoscope operator to familiarize himself with the capabilities of the instrument.
- d. Carefully, and with two hands, remove the Reflectoscope from the carton and visually inspect it for any signs of damage such as dents or scratches. If any damage is found, immediately contact the carrier and the area representative for Automation Industries, Inc., Sperry Division. Do not destroy the shipping container until a satisfactory inspection has been completed. It is suggested that the shipping container be retained and stored in a suitable location.

2.3 PREPARATION FOR USE

Installation of the unit is accomplished by placing the Instrument in a desired location. A firm base is suggested to minimize the chance of the unit falling. It is also suggested that the unit be placed in a tilted face up position for easier and precise instrument waveform viewing.

2.4 ELECTRICAL INTERCONNECTIONS

Application of AC power to the UM-771/775 Reflectoscope.

- 2.4.1 The UM-771/775 Reflectoscope Unit will be shipped in a 115 VAC input power source configuration, unless otherwise specified.

CAUTION

The Proper operating line frequency should be between 50 and 60 Hz. Operating the instrument below 50 Hz or above 60 Hz could cause severe damage to the instrument. Blower motor will not operate at those frequencies and could cause instrument components to overheat.

- 2.4.2 Connect the input power source, 115 VAC, 60 Hz to the three prong connector J107 at the rear of the unit. If 230 VAC input power source is to be used, refer to Paragraph 2.4.2.1.

- 2.4.2.1 The following steps should be followed in changing the UM-771/775 Reflectoscope input power source from 115 VAC to 230 VAC.

TABLE 2-1

Fuse Values for 115V and 230V Line		
Line Voltage	UM-771	UM-775
115 V	5 AMP*	2.5 AMP*
230 V	2.5 AMP*	1.25 AMP*

* Slow Blow

CAUTION

With the Reflectoscope in the OFF position, the input power source, 115 VAC, is present at J107 and J108. Always disconnect 115 VAC power cord before any maintenance or modification is performed on the unit.

- a. Disconnect Jumper wire Pin 8 and 16 of P104 and reconnect jumper wire to Pin 8 and 12 at P104.
- b. Disconnect AC wire connections at J108. Do not disconnect ground wire at J108.
- c. Disconnect Jumper wire Pin 4 and 12 of P104 and connect Pin 4 of P104 to the one side of J108.
- d. Connect the other side of J108 to Pin 12 of P104.
- e. Change F101 and F102 from 2.5 AMP to 1.25 AMP fuses.
- f. Change voltage nameplate to the appropriate A.C. input voltage.
- g. After completing the proceeding steps (a to f), the Reflectoscope is now ready to operate on 230 VAC, 50-60 input Hz power source.

2.5 Initial Reflectoscope Checkout.

2.5.1 Push ON/OFF button to energize the Reflectoscope. Button light should energize.

2.5.2 Check if the blower motor fan is energized and running smoothly. The direction of the air flow should be from the Outside - IN (pressurized).

NOTE

Do not obscure the air intake screen with loose paper, etc. This could cause air blockage and cause the Reflectoscope to overheat.

2.5.3 After approximately one minute, a sweep trace should appear on the CRT.

CAUTION

If the intensity is allowed at a high level of brightness for long periods, it is possible to permanently burn a line on the CRT tube.

- 2.5.4 Adjust astigmatism and focus for the sharpest trace if necessary.
- 2.5.5 Check if the Horizontal sweep line is positioned at the zero scribe line. Use the horizontal and the vertical controls to position the sweep line if necessary. The sweep line should be of equal brightness from left to right of the CRT. The sweep line should also be parallel to the zero scribe line.
- 2.5.6 The Reflectoscope should now be ready for use. To check the Reflectoscope operational control functions, refer to Chapter 3, Section 3.4.

CHAPTER 3

OPERATION

3.1 GENERAL

The purpose of this chapter is to give the operator the proper instructions for control and operation familiarization of the UM-771/775 Reflectoscope. It is recommended that the inexperienced operator thoroughly read and study this section prior to doing any ultrasonic testing. A brief introduction to the Principles of Ultrasonic Testing is located in Appendix B and is also suggested for the novice operator to read and study.



Figure 3-1 UM-771/775 Display Front Panel Controls

3.2 CONTROLS, CONNECTORS AND INDICATORS

The controls, connectors, and indicators herein are those for the UM-771/775 Reflectoscope display unit.

3.2.1 UM-771/775 Reflectoscope.

3.2.1.1. Control Groups (See figure 3-1)

The display contains the following front panel controls which are grouped into functional categories. The trace adjustments are located to the right of CRT and on the Timer unit. The ON/OFF button is located on the left of the CRT Bezel.

a. Trace Screwdriver Controls are:

- ① ASTIG.....CRT Astigmatism Control
- ② INT.....CRT Intensity Control
- ③ FOCUS.....CRT Focus Control
- ④ ALTN.....Alternate Trace Control
- ⑤ HORIZ.....Horizontal Centering Control
- ⑥ VERT.....Vertical Centering Control

b. Miscellaneous Control

- ⑦ Power - Main Power ON/OFF Switch

3.2.1.2 Trace Adjustment Controls (See Block Diagram Figure 3-2)

- a. **ASTIGmatism Control** - The ASTIGMATISM Screwdriver Control is located right of the CRT and is used to correct for any Trace Astigmatism. In general, the INT, FOCUS, and ASTIG Controls should be alternately adjusted several times until the desired overall brightness and sharpness are obtained.

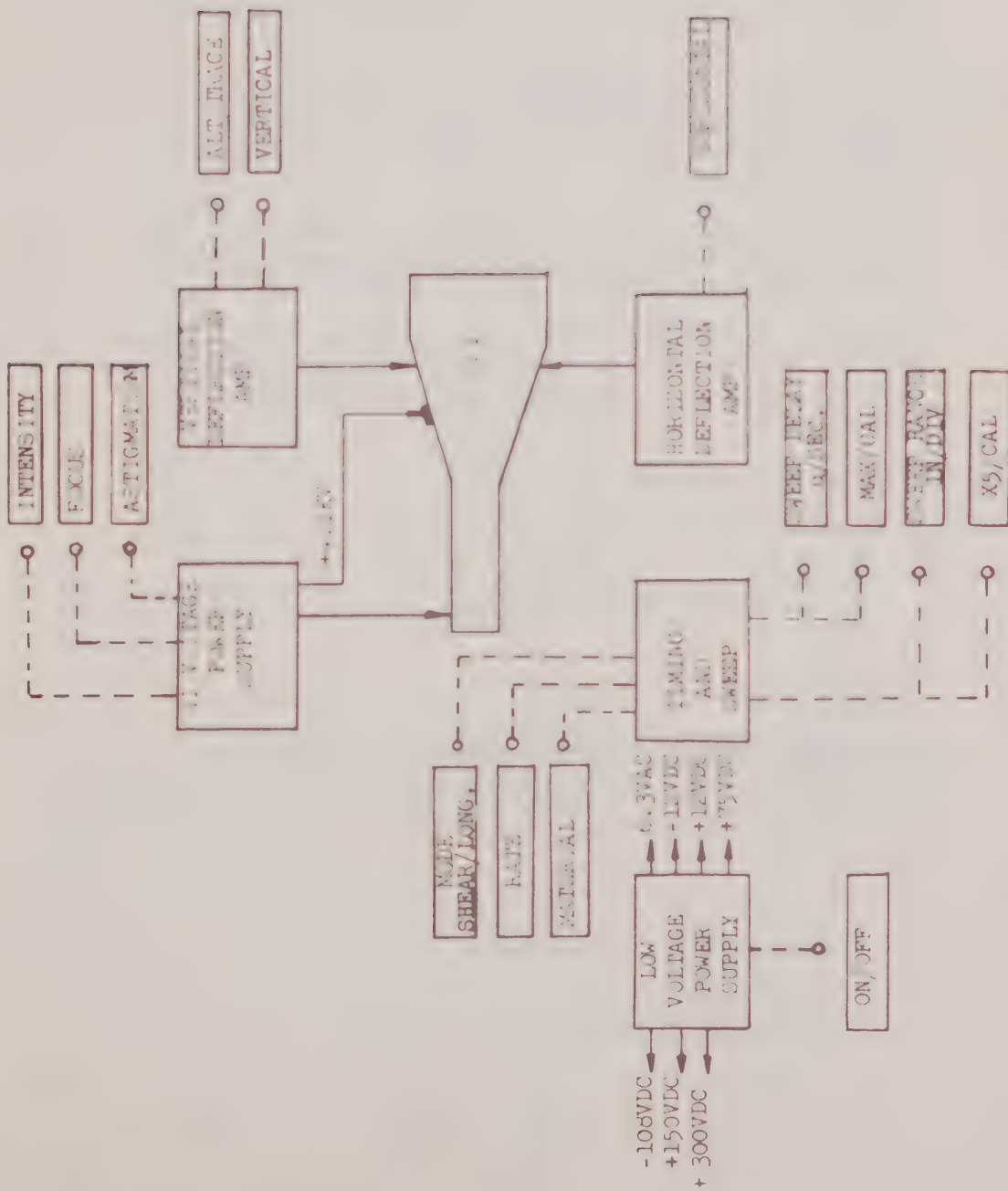


Figure 3-2 Block Diagram of the Timer Display UM-771, 775 Reflectoscope

- b. **INTensity Control** - The **INTENSITY** Screwdriver Control is located on the right side of the CRT and is used to control the brightness of the trace on the cathode-ray tube display.
- c. **FOCUS Control** - The **FOCUS** Screwdriver Control is located under the **INTENSITY** Control and is used to adjust the sharpness of the trace. Changes in the **INTENSITY** Control will usually require a slight readjustment of the **FOCUS** Control.
- d. **ALTN. Control** - The **ALTERNATE** (vertical) Screwdriver Control is located in the Timer unit. The Alternate Centering Control is used for positioning the Alternate CRT Trace vertically.
- e. **VERTical Centering Control** - The vertical screwdriver is located in the Timer unit. The **VERTical** Centering Control provides for positioning the CRT trace Vertically.
- f. **HORIZontal Centering Control** - The Horizontal a Screwdriver Control is located in the Timer unit. The **HORIZontal** Centering Control is used for positioning THE CRT TRACE **HORIZONTALLY**.

3.2.1.3 **Miscellaneous Control**

- a. **Power Switch** is located to the left of the CRT. By pressing the ON/OFF White Power (button) switch the UM-771/775 Reflectoscope will energize or de-energize. The White Power Button will light when in the energized position.

3.2.1.4 **Internal Controls**

In general, internal controls seldom, if ever require adjustment, All internal controls are adjusted during final instrument checkout and should only be adjusted during instrument maintenance line-up. (See Chapter 5)

3.3 OPERATION (FAMILIARIZATION)

3.3.1 Basic Training Procedure

The purpose of this section is to provide the new operator with a knowledge of the basic operating procedures **Contact, Thru and Immersion** testing techniques employed in ultrasonic testing with a Sperry UM-771/775 Reflectoscope. This section is not intended to be a complete instruction on Reflectoscope operation- its purpose is merely on familiarization and training. **Contact** testing refer to section 3.3.3, **Thru** testing Section 3.3.6, and **Immersion** testing section 3.3.7.

Testing with the UM Reflectoscope is both rapid and simple. However, it does demand, on the part of the operator, a complete familiarity with the instrument, with testing techniques and with the physical characteristics of the material being tested.

The new operator should follow the instructions given in this section the first time he uses the instrument. It is recommended that the procedures be run through several times thereafter, and that the operator experiment with various combination to further familiarize himself with the operating characteristics of the instrument.

NOTE

While specific procedures may vary in detail depending in the particular selections of plug-in components, the instructions in this Section are designed to provide basic training for general UM Reflectoscope testing.

3.3.2 Setup Procedure

a. Preparation For Use

1. Assemble the following accessory equipment:

- (a) **Waste** cloths and special multi purpose couplant.
5 Oz. tube. (Sperry Part No. 50A4085)
- (b) Test block Sperry Style No. 50A099
- (c) Search Unit (2.25 MHz) and Cable

2. Place Reflectoscope on work bench or other suitable location.
3. Check to assure that the Pulser/Receiver unit is securely plugged in and kurlled locking knobs are turned finger tight.
4. Connect AC power cord to power plug J107 at the rear of Reflectoscope Cabinet.
5. Connect 3-prong AC power cord to input AC power supply (See Nameplate).

Make certain that the Reflectoscope is grounded. A grounding wire is provided in the 3-wire power cord but in some locations, additional grounding may be necessary.

3.3.3 Familiarization (Contact Testing)

The following procedures are outlined to give preliminary familiarization with UM Reflectoscope Componet controls:

a. Display Unit

- (1) Set display controls at the following approximate positions:
 - (a) Power Switch - Push ON/OFF button to energize UM Reflectoscope.
 - (b) Intensity - Adjust for proper brightness.

CAUTION

If intensity is allowed at a high level of brightness for long periods, it is possible to permanently burn a line or spot on the CRT tube.

- (c) Astigmatism and Focus - adjust for sharpest trace on both vertical and horizontal lines.

b. Timer Unit

1. Horizontal Positioning - set to place sweep start at left edge of the screen.
2. Vertical Positioning - adjust so that trace line appears on zero scribe line on bezel.
3. Sweep Control - Set range controls to .1" per division.

NOTE

CAL (calibrate) Vernier controls on Timer-A are equal to an exact multiplier factor of one (X1) in sweep control and delay control positions. When the Vernier control ranges are other than in the CAL position, the multiplier factor is only an approximation number.

4. Delay Control - Set delay control to 0 μ /sec.

c. Pulser/Receiver Unit

1. Reject - minimum position (full counterclockwise).
2. Pulse Length - quarter turn from full counterclockwise.
3. Connect one end of search cable to connector marked R on front panel of Pulser/Receiver unit.
4. Connect other end of cable to a 2.25 MHz straight beam search unit.
5. Test Mode - Normal or echo
6. Sensitivity - Mid-range
7. Frequency - Set to frequency of search unit.

3.3.4 Familiarization - Detail

With search unit over large hole as in Figure 3-3, use the Sensitivity control to vary the amplitude of indications and set control so that the back reflection appears approximately 2.3" high.

a. Pulser/Receiver

- (1) Study the action of the Pulse Length control. Longer pulse for penetration, shorter pulse for resolution. Set Pulse Length control full CCW for shortest pulse.
- (2) Study the action of the Reject control. Note that the indications are shortened as more reject is applied by turning control clockwise. Although the indications appear to be shortened as with Sensitivity control, note that the smallest indications disappear completely when enough reject is applied. Sensitivity reduces or increases the amplitude of all indications proportionately whereas reject is used to "clip" off the bottoms of indications to remove undesirable small signals. (Figure 3-4). Return Reject to OFF, full CCW and it should remain OFF during familiarization operations.

CAUTION

The Reject Control should be used with discretion. The operator should always bear in mind that even small indications may be important when interpreting test patterns of the CRT display. Use of reject destroys linearity of signal amplitude relationship, thereby making evaluation of defect size difficult or impossible.

d. Testing

Using Test Block (50A099), place a few drops of the multi purpose couplant on the long edge surface with large test hole away from the couplant surface. Place search unit on the couplant surface and note indications appearing on CRT. It may be necessary to change sensitivity so that first back reflection is 2-1/4 inches in height. Moving the search unit back and forth along the couplant surface, locate test holes on the scope, then by changing each of the controls, become familiar with the result of such adjustments. (Figure 3-3).

NOTE

All voltages are internally regulated to provide stable operation within voltage range from 105 - 125 volts. Should additional regulation be required, a Sola Constant Voltage Transformer, Sperry No. 50C383 (Sola 23-22-150) should be used.

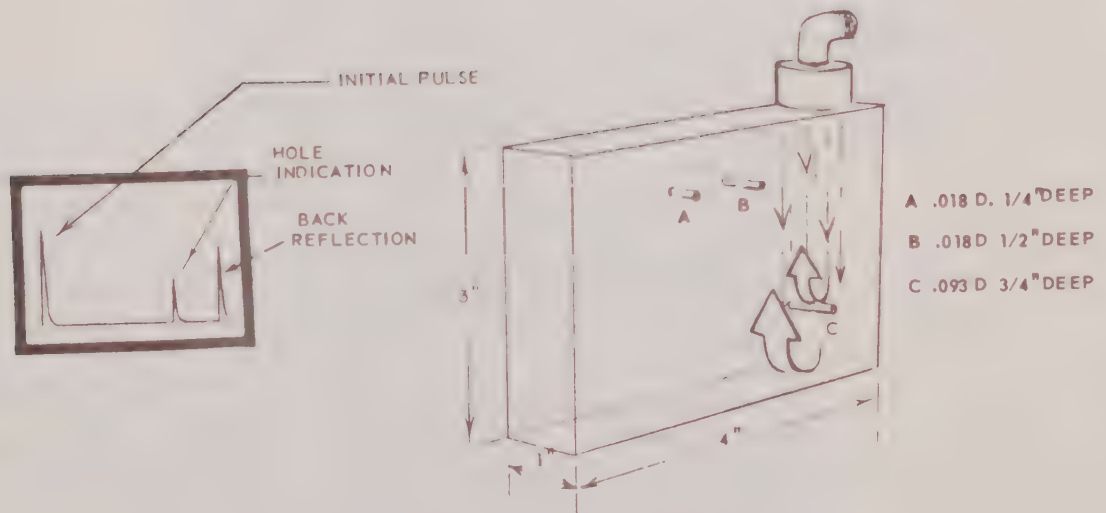
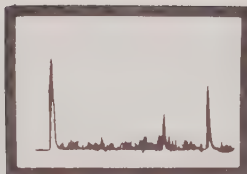
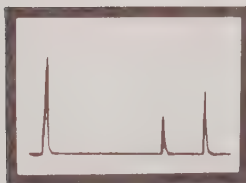


Figure 3-3 Test Block 50A099 and CRT Waveform



WITHOUT REJECT



WITH REJECT - SMALL BASE
LINE SIGNALS HAVE BEEN
CLIPPED OFF PRESENTING A
CLEANER BASE LINE

Figure 3-4 Various Reject CRT Waveforms

b. Display/Timer Unit

- (1) Place search unit on block so that only the Back Reflection shows. Increase sweep range and note that the Back Reflection moves to the left toward the Initial Pulse and that more indications appear moving in from the right side of screen. (Figure 3-5). Sound bounces off the bottom of the block and travels to the top of the block where a portion is transformed into electrical energy by the crystal, is amplified and displayed on the screen as the first Back Reflection. Some of the sound bounces back down to the bottom of the block and then again to the top and appears on the screen as the second Back Reflection. This bouncing between top and bottom surfaces is repeated until the sound is completely attenuated. All these bounces appear on the screen as multiples of the first back Reflection and are equally spaced on the trace. In other words, if the distance between top and bottom surfaces of

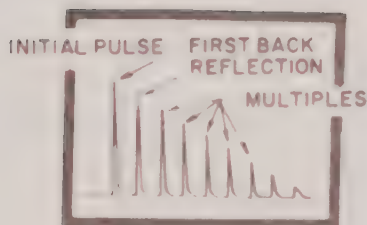


Figure 3-5 Back Reflection CRT Waveforms

the block is 3", then ten multiples of the Back Reflection will represent 30". The Sweep Range controls allow us to see more time, more material or deeper into the material.

2. Place search unit to a position on reference block at which only the back Reflection shows. Set Sweep Control to .5" per division. The leading edge of the Initial Pulse and the leading edge of the Back Reflection should appear as shown in Figure 3-6 when the material control has been adjusted for aluminum.

NOTE

The waveform is deflected six divisions. One division equals 0.5 inches.

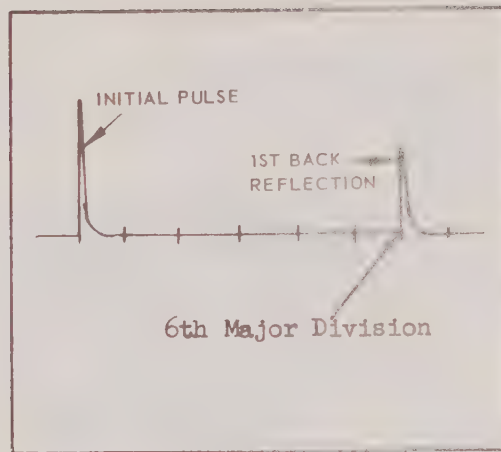


Figure 3-6 Initial Pulse and 1st Back Reflection

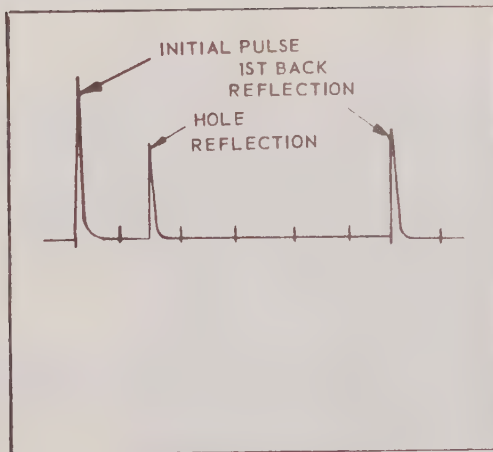


Figure 3-7 Initial Pulse, Hole and 1st Back Reflection

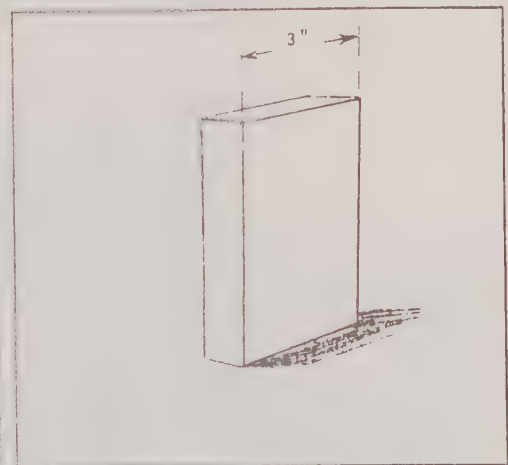


Figure 3-8 Position of Test Block



Figure 3-9 CRT Waveform When Sweep Delay Controls Increased

NOTE

It is important to become completely familiar with Sweep Delay Controls and Sweep Length Controls in order to understand what we see on the screen and to know what part of the test piece they represent. Sweep Delay Controls permit you to "see" a portion of the material at a distance from the test surface. Sweep Length Control allows you to see more or less material.

Also refer to Timer Manual for Timer explanation on the delay and sweep control functions.

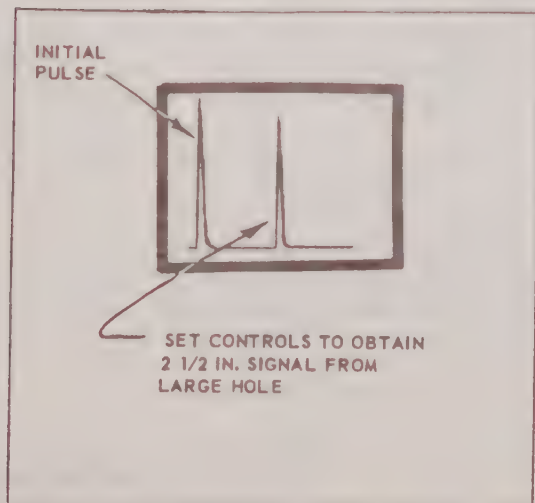


Figure 3-10 Various CRT Hole Reflections

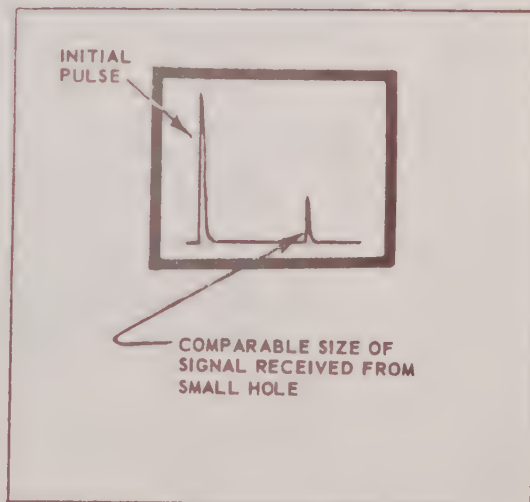


Figure 3-11 Various CRT Hole Reflections

- (3) Move search unit over large hole and check number of divisions to hole indication.
- (4) Slide search unit to the left along top of block until the reflection from the middle hole appears on CRT. Note that the hole is $3/4$ " (1 and $1/2$ divisions) from the top surface. (Figure 3-7).
- (5) Repeat above steps with search unit over other small hole.
- (6) Turn block so that it rests on its three-inch surface (Figure 3-8). Place search unit on top surface so that only Back Reflection appears.
- (7) Set Sweep Control 2" per division. Note that Indication Display trace appears to move to the left. Position three back reflections on CRT. Check with scale calibration. This is set for 2 inches/div. Third reflection should occur at 6 divisions.
- (8) Try several other measurement combinations. Check each measurement with the scale calibration.
- (9) Review preceding steps until a thorough understanding of the use of a reference block, and scale calibration for measuring distance is attained.
- (10) With search unit on 3" surface of block, increase sweep range controls and note that more indications appear on CRT. We are "seeing" more time, in other words the visible sweep represents a greater distance.
- (11) Decrease sweep range controls and note that the indications move off screen to the right until only one Back Reflection is left. We now "see" less time or shorter distance.
- (12) Place search unit on 3" surface of reference block to obtain Back Reflection.
- (13) Increase Sweep Delay controls and note that the first Back Reflection moves toward the left side of screen. We are now seeing a segment of time further away beyond the position of the back Reflection. (Figure 3- 9).

- (14) Set Sweep Control to 1.5 inches and Delay Control so initial pulse starts at first reference mark.
- (15) With search unit over the large hole, set controls to obtain a 2-1/2" hole indication. (Figure 3-10).
- (16) Move search unit over small hole and note the difference in size of hole indications. (Figure 3-11).

3.3.5 Angle Beam Testing Technique (Contact)

The procedure for familiarization with the angle beam technique is similar to that used for the straight beam technique. The angle beam search unit is designed so that the sound beam enters the material under test at an angle to the surface on which the search unit is applied. The following procedure should be used by a new operator in order to familiarize himself with the angle beam testing technique:

- a. Set up the Reflectoscope for use. Allow warm-up period for five minutes.
- b. Select a 2.25 MHz type OM or a 45° angle beam search unit and attach to the search cable.

NOTE

When the angle beam SU is attached, the initial pulse broadens and small signals appear close to the initial pulse. This is a result of reverberations within the search unit. It is normal and these signals should not be confused with signals from defects or the back reflection.

- c. Position controls of the Reflectoscope as follows:

- | | |
|-------------------|------------------------|
| (1) Pulse Length | - 1/4 Turn cw. |
| (2) Pulse Tuning* | - Adjust as required |
| (3) Sweep Control | - 20 |
| (4) Frequency* | - 2.25 MHz |
| (5) Sensitivity | - (Adjust as required) |
| (6) Reject | - OFF |
| (7) Test Mode | - Echo or Normal |
| (8) Long/Shear | - Shear |

*Optional controls on Pulser/Receiver unit.

- d. Place the standard test block so that the large hole faces you and is at the lower right.
- e. Place a few drops of SAE 30 engine oil on the top surface of the block.
- f. Place the 45° search unit on the block as shown in Figure 3-12. For most satisfactory results, the SU should be worked back and forth and, at the same time, twisted slightly side to side in a rotary motion so as to cover an arc of 20 to 30 degrees. This assures complete coverage of the material under test. (Figures 3-12 and 3-13).
- g. Move the search unit slowly to the left end of the block until a picture similar to that in Figure 3-13 appears.

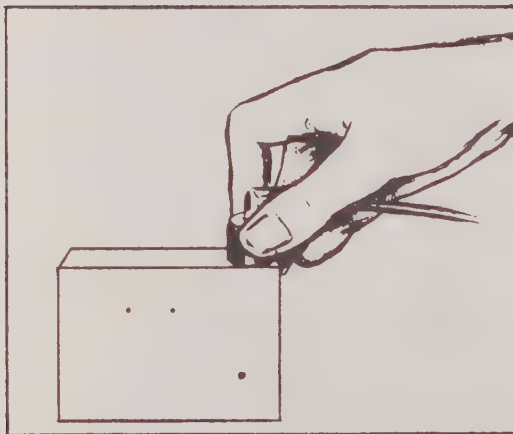


Figure 3-12 Angle Beam Search Unit Placed On Standard Test Block

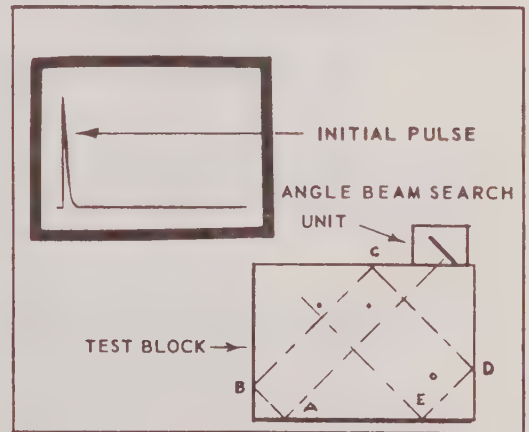


Figure 3-13 Path of Angle Sound Beam Through The Test Block. No Reflection From Holes

NOTE

The path of a beam at this time is shown in Figure 3-13. It will be seen that the beam is progressing from surface to surface inside the block from A to B etc. and that it fails to strike any defect surfaces which are in a position to reflect the sound beam back to the search unit. Eventually some of the sound beam may return to the search unit surface. However, because of attenuation or weakening of the beam as it travels through the material, the beam may be dissipated before the return path is completed. As mentioned in the preceding note, the operator will observe that several small indications appear along the base line when the SU is attached to the cable. These are due to reflections from within the search unit. Not all the sound energy passes through the plastic wedge of the search unit to the test surface. Some of it reflects around inside the wedge until it strikes the crystal, causing what appears to be a wide initial pulse even at a minimum Pulse Length setting. Additional small reflections appear when the Search unit is applied to the test block. These reflections are from the side of the test block and are due to the fact that the beam does not travel perfectly parallel, but fans out somewhat from the crystal face. The small return signal halfway out on the base line is a result of a portion of the beam reflecting from around point D directly back to the SU. This action becomes more understandable upon proceeding to the next step.

- h. Slide the search unit slowly toward the left until a pattern similar to that shown in Figure 3-14 is attained.

NOTE

By checking back to the diagram of the sound path in Figure 3-13, the presence of the large reflection is easily understood. Careful observation of the screen may reveal a small reflection near the initial pulse. This can be explained by the fact that the .018 inch diameter by 1/2" deep hole in the middle of the block is being intercepted by the divergent sound beam.

- i. Move the search unit further to the left. This will bring about a growth of the middle hole reflections and a reduction of the return from the opposite corner of the block. (See Figure 3-15).
- j. Continue moving the search unit along the block until patterns similar to those shown in Figures 3-16 , 3-17 and 3-18 are obtained.
- k. Repeat the foregoing procedure until complete familiarity with the angle beam search technique is attained.

3.3.6 THRU-TRANSMISSION (Two-crystal operation - contact)

- a. Assemble the following items in addition to those required for single search unit operation:
 - (1) Standard 6' 4" cable.
 - (2) Two 4' 8" cables.
 - (3) Two straight beam search units of the same frequency (2.25MHz for this test).
 - (4) Aluminum block with saw cut notch. (See Figure 3-19).
- b. Connect one end of a 6' 4" cable to the receptacle marked "R" and to the other and connect a 2.25MHz search unit. This becomes the Receiving search unit.

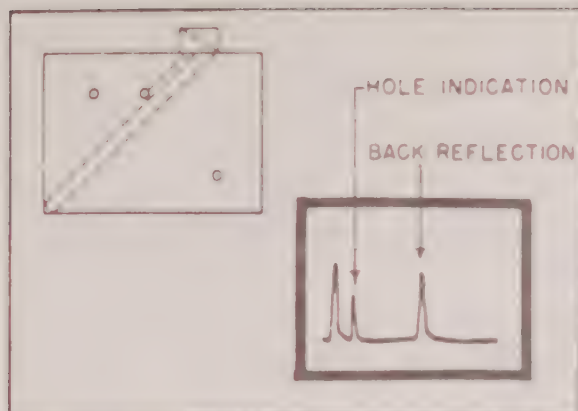


Figure 3-14 Beam Reflected From Middle Hole and From Corner of Test Block

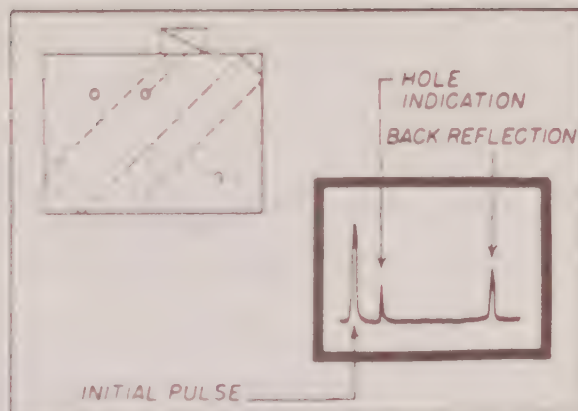


Figure 3-15 Increased Return From Middle Hole and Decreased Return from Corner Results In a Pattern As Above

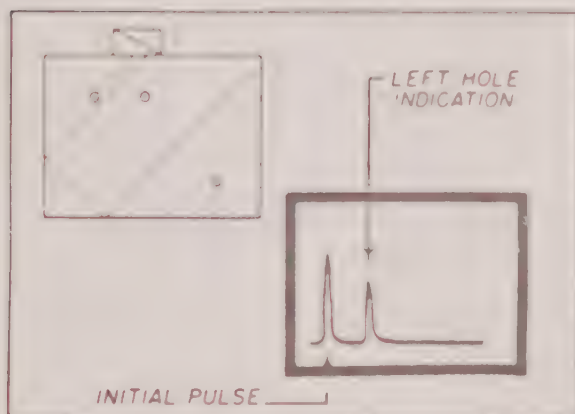


Figure 3-16 Reflection From Small Left Hand Hole

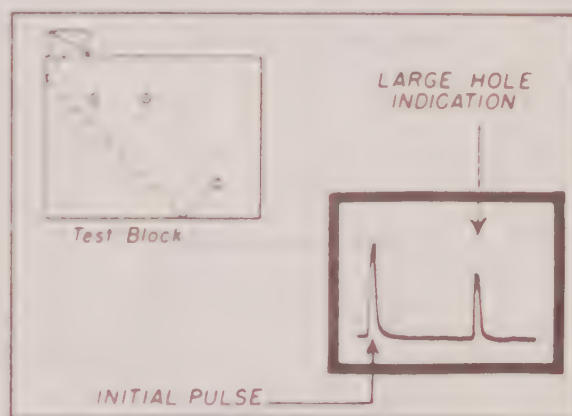


Figure 3-17 Reflection From Large Hole At Lower Right

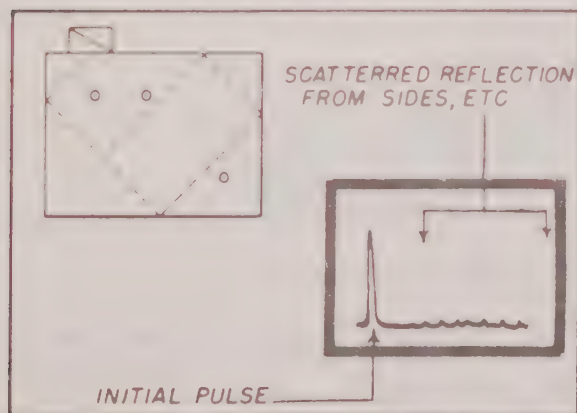


Figure 3-18 No Reflections Are Obtained When The Searching Unit is in the Position Shown Above

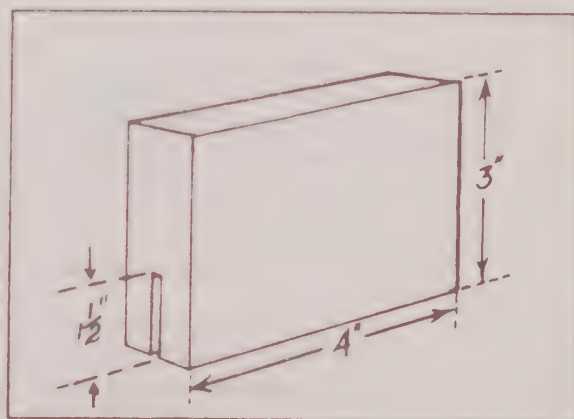


Figure 3-19 Aluminum Block with Saw Cut Notch

- c. Connect one end of a 4' 8" cable to the receptacle marked "T"
A 2.25MHz search unit is connected to the end of the second cable. (See Figure 3-20).

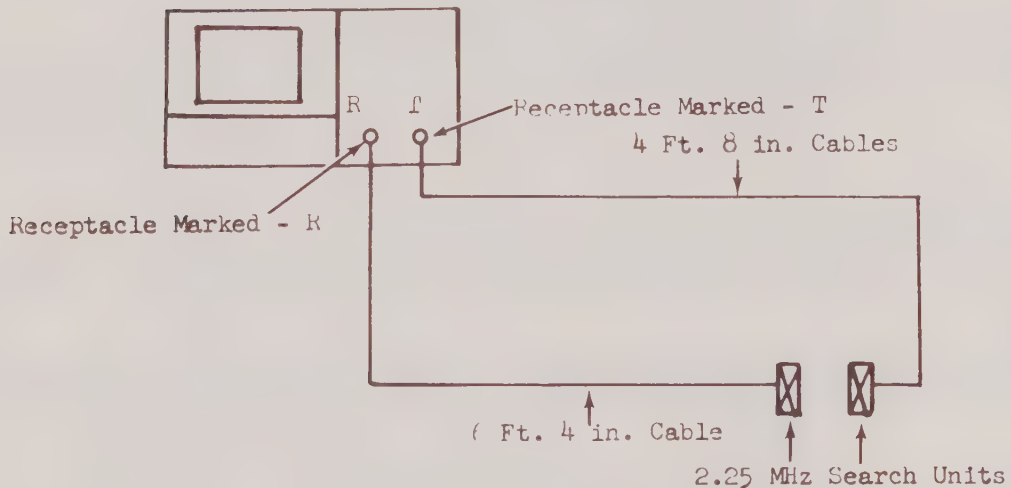


Figure 3-20 Cable Connections for Two Crystal (Thru-Transmission) Testing

- d. Set controls as follows:

- | | |
|-------------------|--|
| (1) Sweep Control | - .1 |
| (2) Reject | - OFF |
| (3) Pulse Length | - OFF |
| (4) Frequency* | - 2.25 MHz |
| (5) Sensitivity | - (As required 2" signal) |
| (6) Test Mode | - THRU (transmission) |
| (7) Pulse Tuning* | - Adjust for maximum signal amplitude. |

*Optional controls on Pulser/Receiver Unit

- e. Position the two search units on opposite sides of the block so that sound travels through the block in a direct line from the transmitting search unit to the receiving search unit.

NOTE

The CRT display shows indications from two sources, the initial pulse (transmitting search unit) and the sound striking the receiving search unit. (See Figure 3-21).

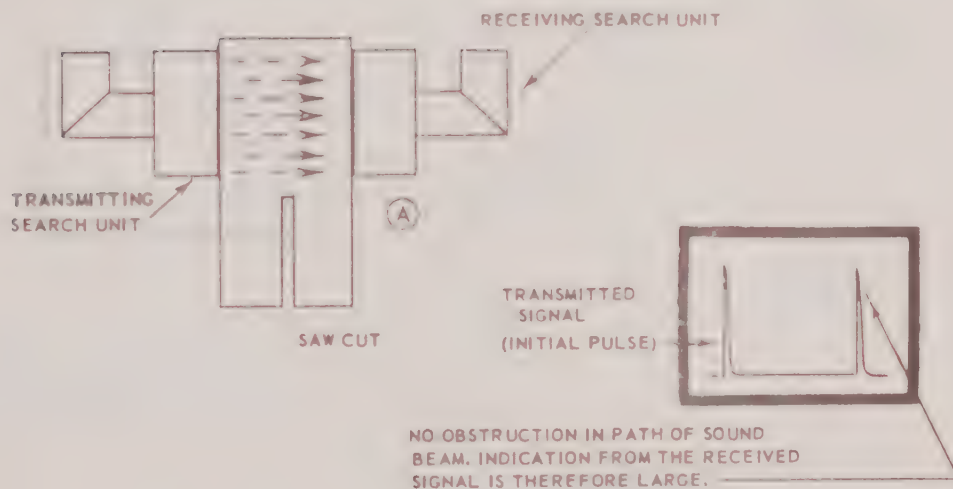


Figure 3-21 Thru Transmission - Position A

- f. Move search units to position B (Figure 3-22). Note that the indication from the receiving search unit is reduced in size or completely deleted. The sound traveling through the block is obstructed by the saw cut and, therefore, less energy reaches the receiving search unit.

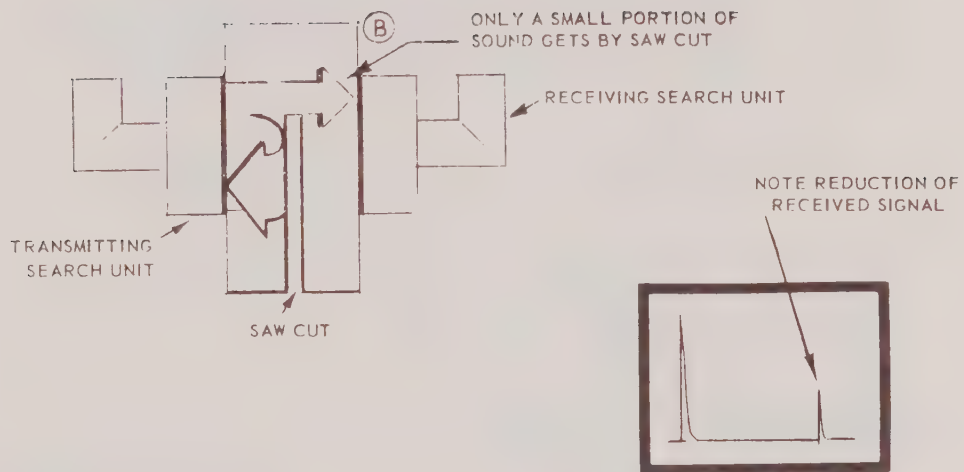


Figure 3-22 Thru Transmission - Position B

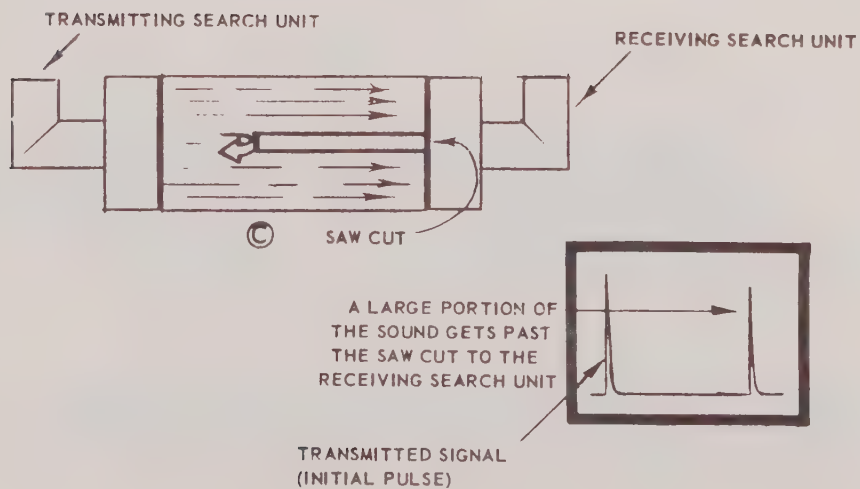


Figure 3-23 Thru Transmission - Position C

- g. Place search units at position C (Figure 3-23). Adjust sweep length until indication appears at right of CRT. Note that the indication from receiving search unit is of greater amplitude than at position B. The saw cut presents less obstructing area scanned from position C than it does when scanned from position B; therefore, it must be borne in mind that even a small loss of amplitude of the received signal may be caused by a large discontinuity if the plane in which it lies is not normal to the sound beam.

3.3.7 SINGLE SEARCH UNIT IMMERSION TESTING

- a. Assemble the following equipment:

- (1) Immersion tank.
- (2) Search unit positioner carriage.
- (3) Search unit positioner.
- (4) Immersion search units.
- (5) Search unit handles.
- (6) Standard 6' 4" search cable.
- (7) Long search cable (25 feet).
- (8) Match networks (as required).
- (9) Test block.

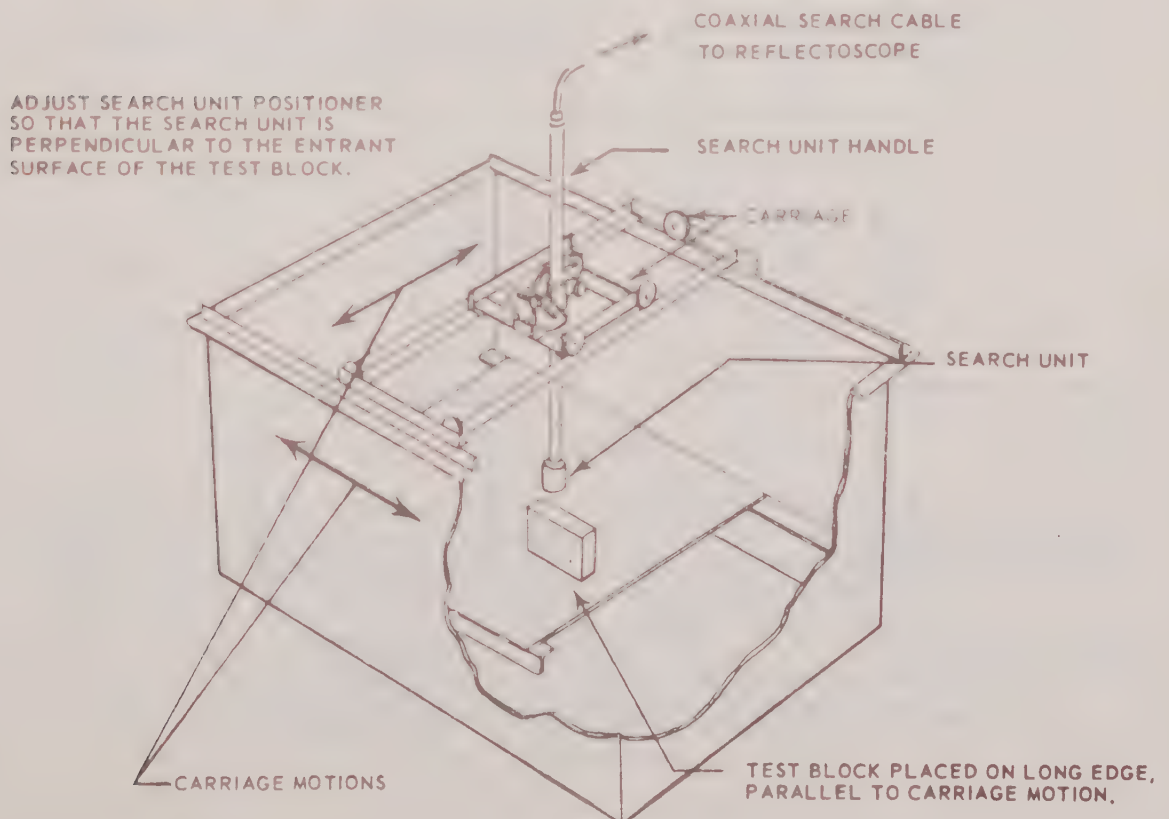


Figure 3-24 Arrangement of Accessory Equipment for Single Search Unit Operation

- b. Mount search unit positioner carriage on tank. (Figure 3-24).
- c. Mount positioner on carriage.
- d. Assemble 5.0 MHz 3/8" SI quartz search unit to a search unit handle, being sure "O" ring on search unit is in place.
- e. Attach standard 6' 4" cable to search unit handle.
- f. Attach other end of cable to receptacle marked "R" on Reflectoscope front panel.

NOTE

Turn connecting rings on search unit cable finger tight only.

- g. Place test block in tank so that it is parallel to one of the carriage motions. (Figure 3-24).
- n. Adjust positioner so that search unit is approximately 1 3/4" above surface of test block. (Figure 3-24).
- i. Set front panel controls to following positions:

(1) Frequency*	- 5.0 MHz
(2) Sensitivity	- (as required 2" signals)
(3) Pulse Length	- minimum
(4) Pulse Tuning*	- tune for maximum signal amplitude
(5) Sweep Control	- 2
(6) Reject	- OFF
(7) Sweep Delay	- Initial pulse at first index mark.
(8) Test Mode	- Normal or Echo

*Optional controls on Pulser/Receiver unit.

- j. Position search unit by moving it over a section of the test block so that the sound beam will encounter no hole. Adjust the angular position of the search unit to obtain a signal of maximum amplitude from the bottom and top surface of the test block. (Figure 3-25).
- k. Notice signal at left side of CRT. This is the initial pulse and is always visible unless more sweep delay is used.

- l. The next large signal to the right of initial pulse is the surface signal or top surface of test block. The distance between the two signals is the distance the sound travels in water. (Figure 3-26).
- m. Set Sweep Control for (.2 inches/div.). Measure the distance from initial pulse to interface. Should be at most 9 divisions or 1.75".
- n. Set Sweep Control (2 inches/div.).
- o. The next signal after the interface indication is the first back reflection representing the bottom of the test block. The second signal to the right of the interface indication is the second back reflection. This is the second interface signal, i.e., it is a signal from

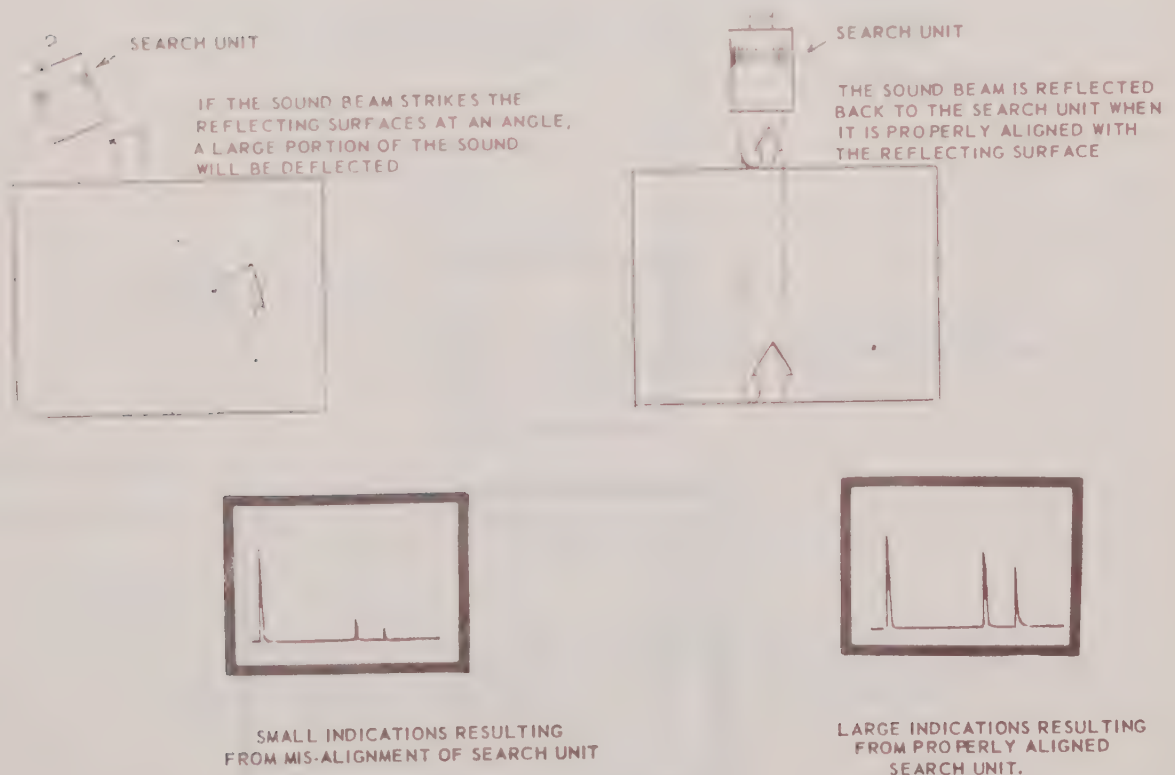


Figure 3-25 Positioning Search Unit for Maximum Penetration

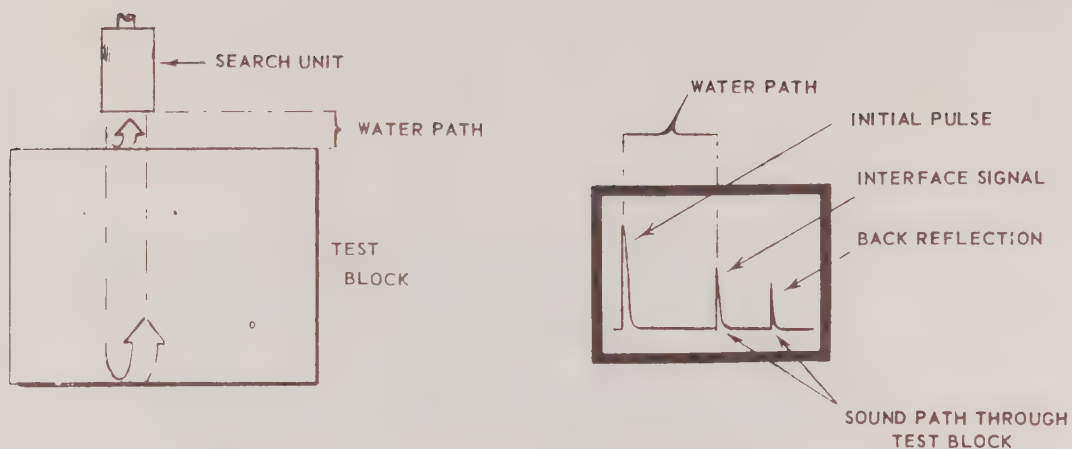


Figure 3-26 Sound Path Through Water and Test Block

the sound energy which has made two trips from the search unit to the top surface of the block and back. (Figure 3-27).

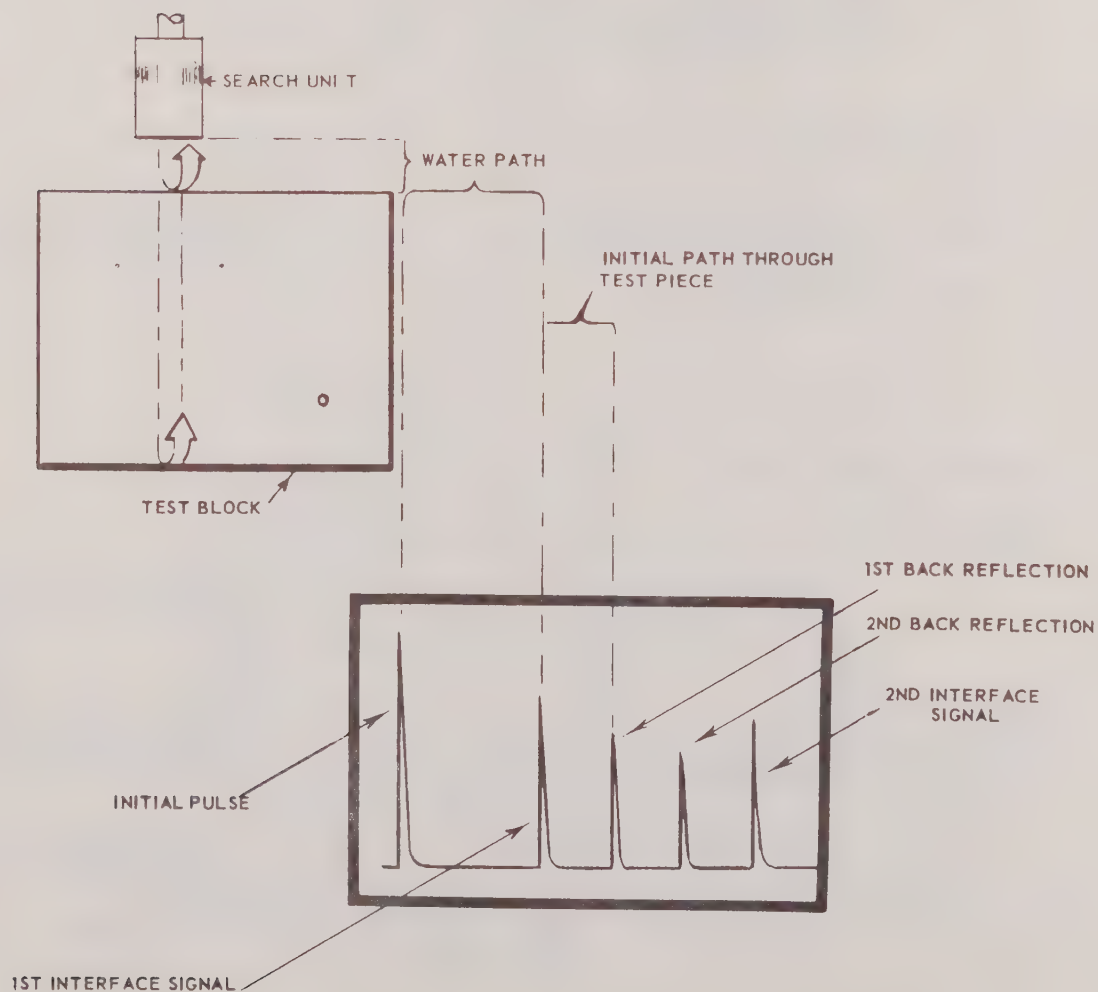


Figure 3-27 Signal Identification

NOTE

At this point, vary the water distance by moving search unit to and away from the test block. Observe that the distance between initial pulse and the interface signal varies and that the distance between the interface and the back reflection remains constant. The reason that the distance between the SU and top surface of reference block appears on the CRT as longer than the distance between top and bottom surfaces of the block, is that the velocity of sound through steel or aluminum is approximately 4 times that of the velocity of sound through water. Having identified these signals, position search unit so that the second interface echo falls to the right of the first back reflection.

- p. Adjust Delay Control until first interface signal is at the left end of sweep line. (This eliminates initial pulse and water path from CRT screen). (Figure 3-26).



Figure 3-28 Elimination of Initial Pulse and Water Path from CRT Screen

- q. Adjust Sweep to move first back reflection to the right end of the sweep line, thus presenting on the CRT only the material depth. (Figure 3-29)

- r. Move positioner over holes in block observing signals appearing between interface and back reflection, increasing sensitivity for desired signal amplitude.
- s. Measurement of depth within the piece may be accomplished by the use of CRT gradicule reference lines. Align the leading edge of the interface signal instead of the initial pulse with the gradicule reference line.

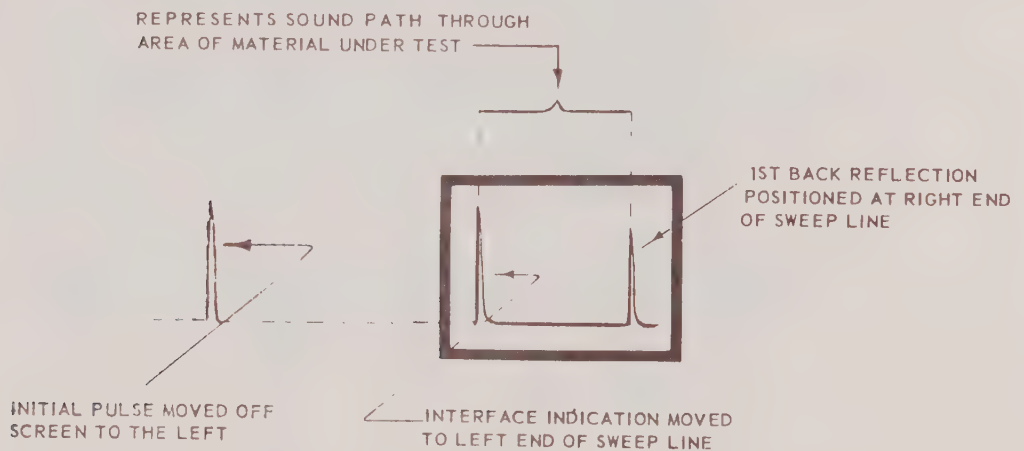


Figure 3-29 Use of Delay Control Position Interface
Signal at Start of CRT Display

3.3.8 THRU-TRANSMISSION IMMERSION TESTING

- a. In addition to the equipment listed in 3.6.a. proceeding, assemble the following:
 - (1) Standard 6' 4" search cable.
 - (2) Search unit handle
 - (3) Two right angle adapters.
 - (4) Search units (both of the same frequency).
 - (5) A fixture to hold search handles in place (Figure 3-30). This is a suggested method of securing two search units on the tank if two positioners are not available.
 - (6) Test block with saw cuts. (Figure 3-31)

NOTE

Keeping the saw cut water tight by sealing with tape will result in easier signal interpretation.

- b. Mount search unit adapters, search unit handles and positioning fixture on tank. Place aluminum block in tank as shown in Figure 3-32

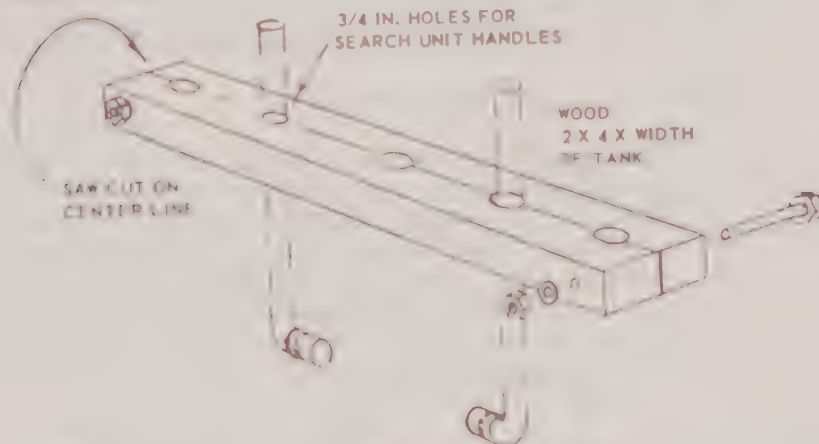


Figure 3-30 S.U. Positioning Fixture

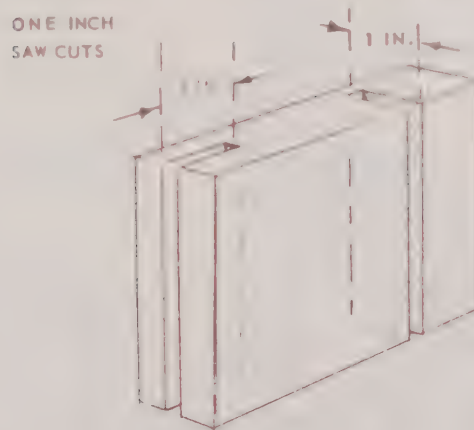


Figure 3-31 Aluminum Block

- c. Connect one end of a standard 6' 4" cable to receptacle marked "R" and the other end to one of the search unit handles.
- d. Connect one end of the second 6' 4" cable to receptacle marked "T" and the other end to the second search unit handle.

e. Set front panel controls to following positions:

- (1) Delay Control - set initial pulse on first index mark.
- (2) Sweep Control - as required.
- (3) Reject - OFF.
- (4) Pulse length - CCW.
- (5) Frequency* - 2.25 MHz
- (6) Sensitivity - (as required 2" signal)
- (7) Test Mode - THRU

*Optional control on Pulser/Receiver Unit.

f. Method of aligning Search units:

- (1) Search units must be properly aligned so that the sound projected by the transmitting search unit will strike the receiving search unit. The CRT display shows indications from only two sources, the initial pulse and the sound striking the receiving crystal. This received signal must be brought to its optimum point by adjusting the search units until the greatest amount of the transmitted sound reaches the receiving search unit. (Figure 3-33)

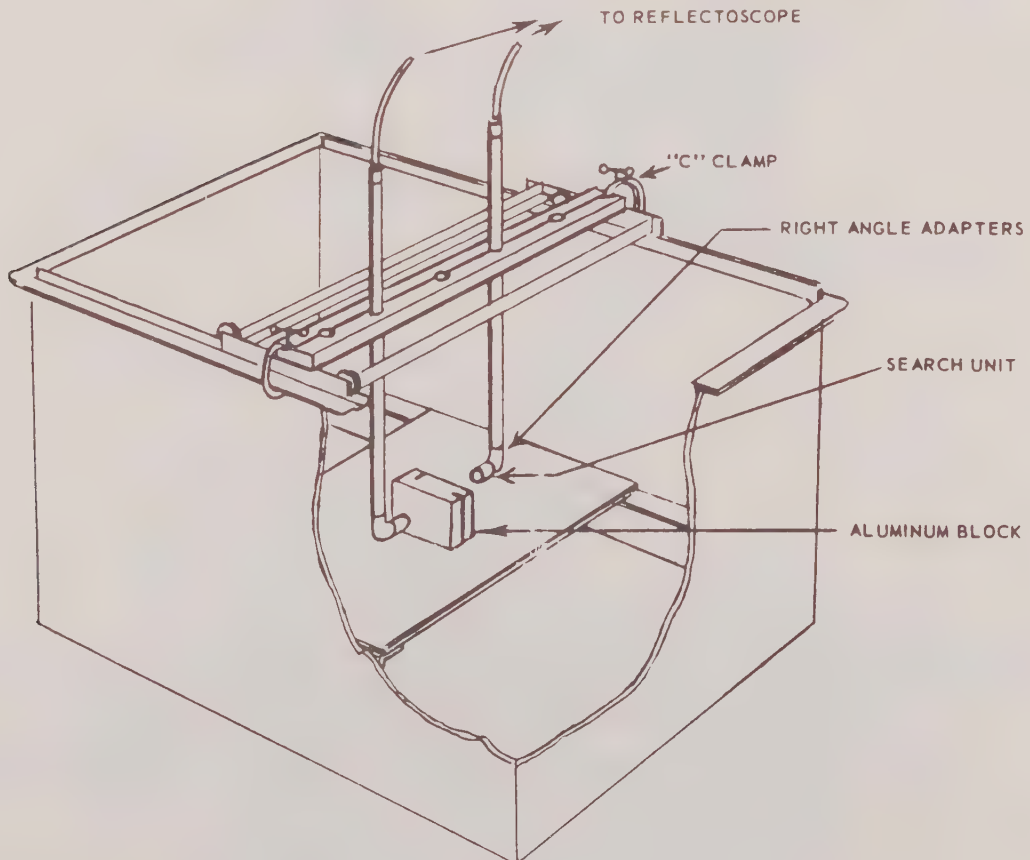


Figure 3-32 Arrangement of Accessory Equipment for Through Transmission

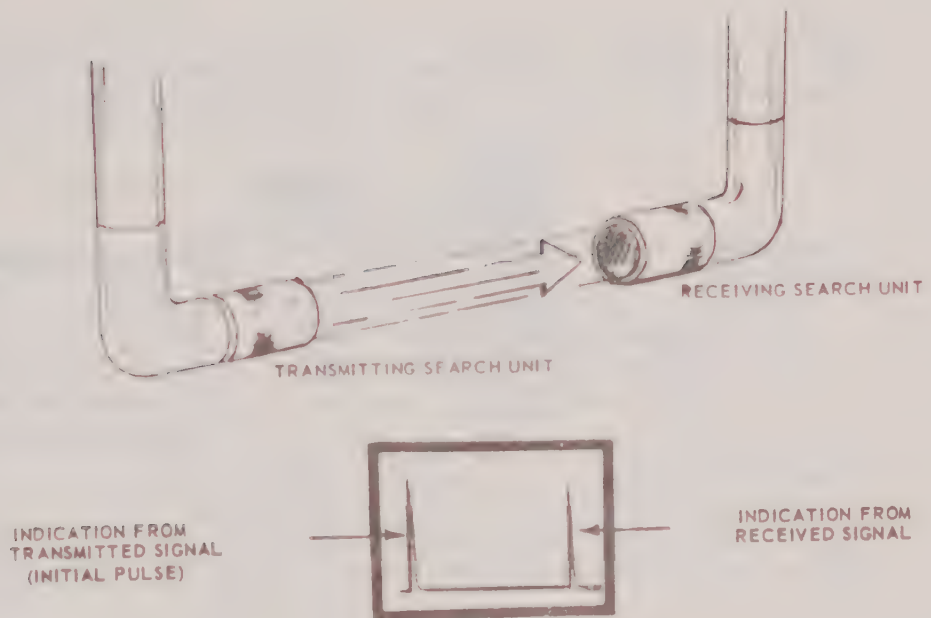


Figure 3-33 Received Signals From Correctly Aligned Search Units

- (2) Position search units so that the sound is directed at saw cut A. (Figure 3-34) Note that the indication from the received signal is reduced in size according to the amount of sound cut off by the saw cut (plan view).
- (3) Position search units so that sound is directed at end of saw cut B. (Figure 3-35) Note that although the saw cuts are of equal dimensions, the indication is much larger when sound is directed at saw cut B. The plan view in Figure 3-33 shows only a small portion of the sound being obstructed by the narrow face presented by the saw cut B.

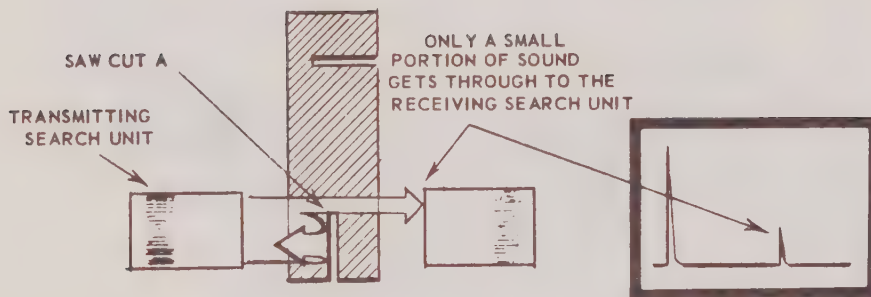


Figure 3-34 Received CRT Waveform

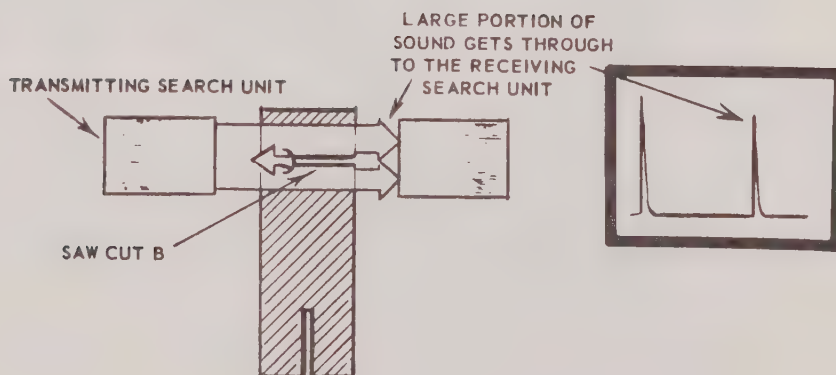


Figure 3-35 Received CRT Waveform

CHAPTER 4

ELECTRICAL DESCRIPTION

4.1 GENERAL

This section describes the theory of operation of the CRT Display UM-771/775 Reflectoscope. This chapter used in conjunction with Chapter 5, Maintenance, will be helpful in troubleshooting the UM-771/775 Reflectoscope for any malfunctions.

4.2 THEORY OF OPERATION - GENERAL

- 4.2.1 There are two separate power supplies; a low voltage power supply and a high voltage power supply. The outputs of the low voltage power supply are used by every major assembly in the display, timing, Pulser/Receiver Plug-in, and accessory plug-in module. The output of the high voltage power supply is used for operation of the CRT.

The UM-771/775 Reflectoscope uses two fuses for Transformer T-101 and low voltage power supply protection. See Reference Schematic 508618 for proper replacement of fuses. The power transformer T-101 in the UM-775 is different from the one used in the UM-771. The differences are physical size, power handling capability and mountings.

- 4.2.2 Input AC voltage is connected to J107 at the rear of the UM-771/775 Reflectoscope unit; it also passes thru F101 and F102 to the ON and OFF Switch S101 and B101. By energizing S101, AC voltage is impressed on the Primaries of A and B Section, and on fan B101. Options for 115 and 230 VAC input can be performed by simply changing the primary taps at P104 (see Chapter 2 Section 2.4.2.1). Primary Transformer taps (T101) are available for special operational voltage modes.

4.2.3 Low Voltage Power Supply

The low voltage power supply has six regulated outputs which are used as follows:

- a. +300V Used in the high voltage power supply, geometry and intensity circuits, and is also used as Plate Voltage for Pulser/Receiver Plug-in unit.
- b. +150V Used in the high voltage power supply and Deflection Amplifier. Also used as Plate voltage in Pulser/Receiver Plug-in unit.

- c. -108V This voltage is used in the
Pulser/Receiver unit and
Astigmatism Circuit.
- d. +75V Used in the Horizontal - Vertical
Deflection Amplifier for transistor
biasing.
- e. +12V Used in the Horizontal - Vertical
Deflection Amplifier and high
voltage circuit.
- f. -12V Used in the Horizontal - Vertical
Deflection Amplifier and high
voltage circuit.

4.2.3.1 Low Voltage Power Supply Components

Physically, the low voltage power supply components are located in the rear of the instrument chassis. There are two major sub-assemblies:

- a. Power Transformer Power transformer contains various set-up and step-down AC voltages sent to the Low Voltage Power Supply P. C. Board Assembly 50D568.
- b. Low Voltage Power Supply. This board contains components which rectify and regulate the six low voltage outputs. All the low voltages are adjustable except the +75V. All supply output voltages are individually fused to protect power supply circuits. See Table 4-1 for the Low Voltage Power Supply Fuse List.

TABLE 4-1

LOW VOLTAGE POWER SUPPLY FUSE LIST

Power Supply Section	Fuse	Value
+300VDC	F201	1/4 Amp
+150VDC	F202	3/8 Amp
-108VDC	F203	1/8 Amp
+75VDC	F204	1/8 Amp
+12VDC	F205	2 Amp
-12VDC	F206	2 Amp

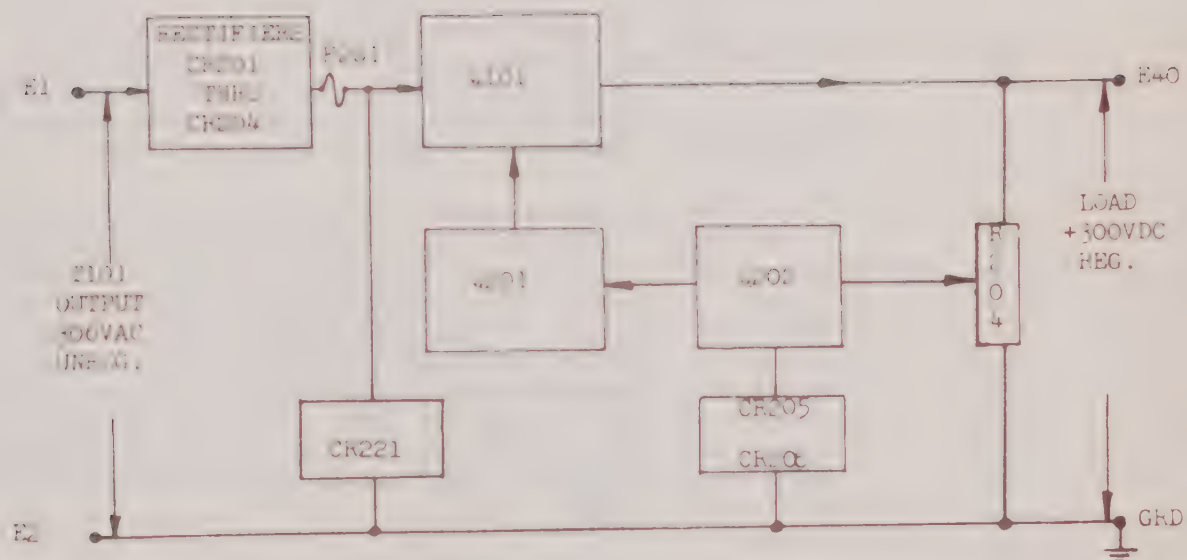


Figure 4-1 Block Diagram of the +300VDC Regulation Circuit

4.3 THEORY OF OPERATION DETAILED

4.3.1 Circuit Description of the Low Voltage Power Supply (see Reference Schematic No. 50E618 and Low Voltage Block Diagram 4-2).

- a. Circuits for the +300V, +150V and -108V power supply are basically the same. The +300V power supply will be explained in detail. The +300V output of the low voltage power supply is developed in a full wave rectifier circuit composed of CR201 thru CR204. All electrical components are located on the Low Voltage P. C. Board except transistor Q101 thru Q105 which are located at the rear of the Reflectoscope heat sink. Capacitor C201 filters the full wave output voltage. A positive voltage with respect to ground appears at the collector input of the series regulator, and base of Q201 and Q202 through dropping resistor R201. These transistors detect the output fluctuations and control the conduction of the series regulator transistor Q101.

The emitter of Q202 is held at a constant reference voltage by Zener diodes CR205 and CR206. Q202 is collector coupled to Base of Q201. The base of Q202 is connected to the center tap of a voltage divider connected across the output of the +300V power supply. As the load on the supply changes, the current through the divider changes varying the conduction of Q202. The voltage changes at the collector of Q202 are directly coupled to the base of Q201, an emitter follower. Q201 drives the series regulator, Q101, which acts as a variable resistor in series with the load to keep the output voltage at a constant +300V level.

Fuse F201 is used to protect +300V power supply components. When 1 ampere of current is felt at E15 (emitter of Q101), fuse F201 will open very quickly. When 300 milliamperes of current is felt at E14 (collector of Q101), R235 will sense high current overload and short CR221 to ground, thereby quickly opening F201 and protecting +300V power supply components.

The +300 DC output voltage is sent to the low voltage board J201 for voltage distribution within the UM-771/775 Reflectoscope.

- b. The +75V power supply is the same as the +300V circuit, except that there is no voltage adjustment on the +75V regulated output circuit.

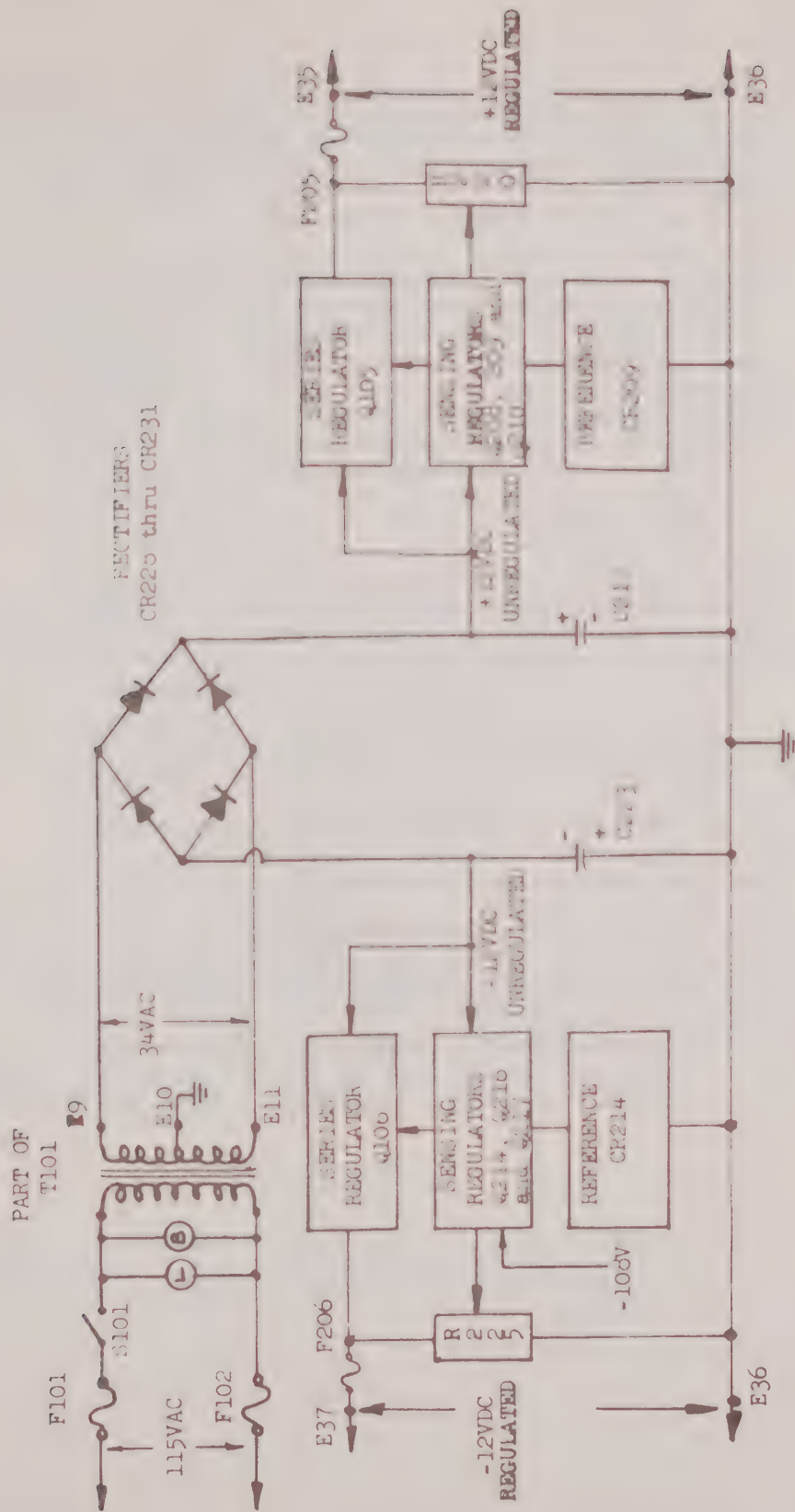


Figure 4-2 Simplified Block Diagram of the +12VDC Power Supply Circuit

A positive regulated voltage with respect to ground appears across C219. The unregulated positive voltage is applied to Q208, Q209 and Q210. These transistors detect the output fluctuations and control the conduction of the series regulator transistor Q105.

The emitter of Q210 is held at a constant reference voltage by Zener diode CR209. The base of Q210 is connected to the center tap of a voltage divider connected across the output of the +12V power supply. As the load on the power supply changes, the current through the voltage divider changes varying the conduction rate of Q210. Voltage changes at the collector of Q210 is directly coupled to the base of Q209 and emitter follower. The output of Q209 is fed to another emitter follower, Q208. Transistor Q208 drives the series regulator Q105 which acts as a variable resistor in series with the load to keep the output voltage at a constant +12VDC.

The negative output voltage from C220 is applied to the sensing and regulating transistors. This circuit is nearly the same as the positive regulator circuit except for those changes required by the use of PNP Type transistors Q106, Q216 and Q217 instead of NPN used in the positive voltage supply regulator. The output of Q217 controls the conduction of the series regulator Q106 to keep the -12VDC output constant. The -108 voltage is used in the -12V power supply to add stability to the control amplifier Q214.

4.3.2 High Voltage Power Supply and Unblanking Circuits

- a. The High Voltage Power Supply provides control grid bias accelerating and unblanking voltages for the CRT. High voltage power supply is located on the right side of the CRT. Removal of the top instrument wraparound cover allows access to the high voltage power supply components.
- b. Circuit Description of the high voltage power supply and unblanking circuits (see Reference Schematic No. 50E618 and Figure 4-3 High Voltage Power Supply Block Diagram).

CAUTION

When measuring voltages in the High Voltage Power Supply, Maintenance Section Personnel should exercise extreme CAUTION. Voltages hazardous to life are present.

The High Voltage Power Supply is made up of a saturable-core square wave oscillator Q301 and Q302 whose tuned circuit includes the primary of a high voltage transformer T301. One step-up secondary winding feeds two high voltage circuits which develop the High DC voltages for the cathode ray tube.

- c. The saturable-core square wave oscillator circuit Q301 and Q302 operates at a frequency of approximately 20KHz. It supplies approximately 16V peak-to-peak to the primary of transformer T301. The secondary of the transformer supplies AC High Voltage. High Voltage is supplied to a half wave rectifier circuit CR303 and CR307 at approximately -1.6KV. High Voltage is also supplied to a voltage doubler circuit CR301 and CR302 at approximately +4.1KV.

The voltage doubler circuit in combination with the single half wave rectifier provides a total accelerating voltage of approximately 5.7KVDC to the CRT. A positive 4,100VDC is supplied to the CRT postanode accelerator by the doubler circuit and a negative 1600VDC is supplied to the CRT cathode, making a total potential difference of 5700VDC between the cathode and postanode accelerator.

The high voltage power supply -1600 is indirectly adjusted by voltage dropping resistor R-332. The controlled voltage output from the dropping resistor to feed to base of Q305. The output of Q305 in turn controls the output voltage of Q307 and Q306 controlling the amplitude output of the inverter circuit (saturable-core square wave oscillator).

- e. A floating power supply is required in order to provide DC coupling for the unblanking voltage to the CRT control grid. The unblanking pulse is superimposed on the CRT control grid voltage through Q304, Q303 and CR308. The unblanking wave form (Figure 4-4) is seen at the plus side of VR308.

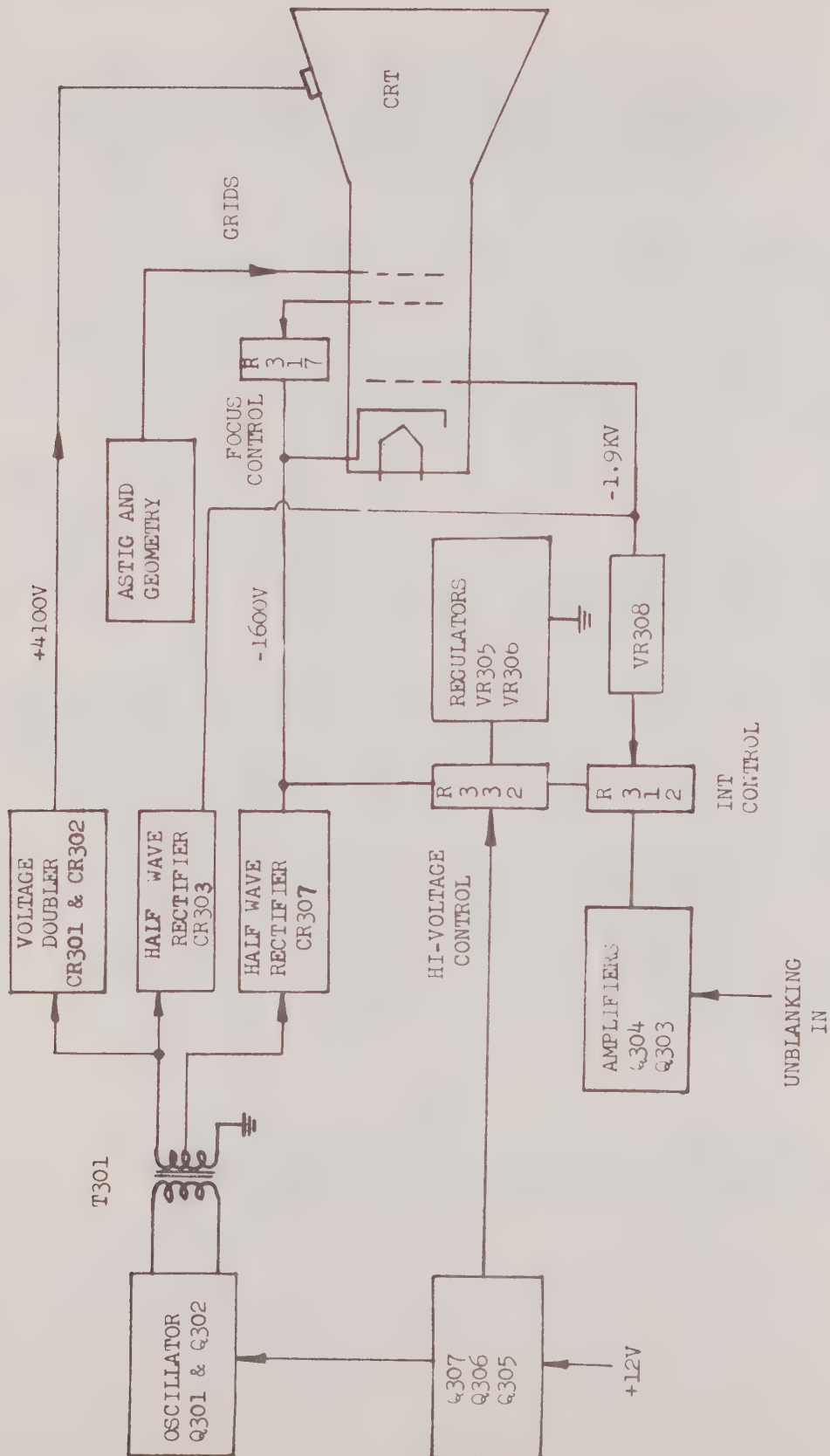
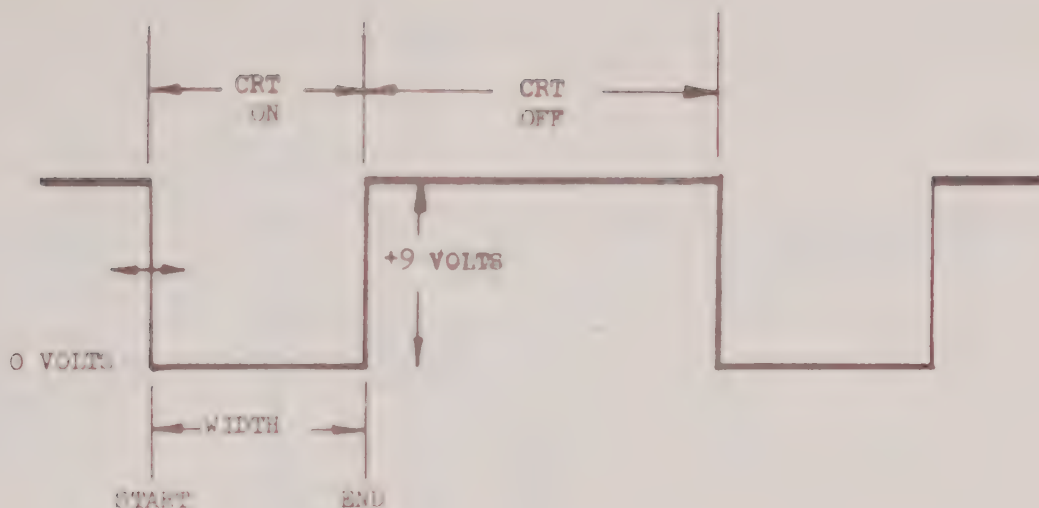


Figure 4-3 Block Diagram of the High Voltage Power Supply and Unblanking Circuit



WIDTH is controlled by Sweep Length ADJUST
 START is controlled by Sweep Delay ADJUST

Figure 4-4 Unblanking Waveform at the Input E2 of the High Voltage Board

- f. The filaments 6.3VAC for the CRT are obtained from the secondary of T101 (Taps 1 and 3). During normal operation the filament voltage 6.3VAC is floating on a high voltage potential of -1600VDC.

CAUTION

Caution should be taken when measuring CRT Filament Voltage.

- g. The focus, astigmatism and geometry circuits control the grid voltages to the CRT for proper sweep presentation functions.
- h. Listed in Chart 4-1 are various CRT Voltage potentials (see Figure 4-5, Schematic of the CRT Circuit).

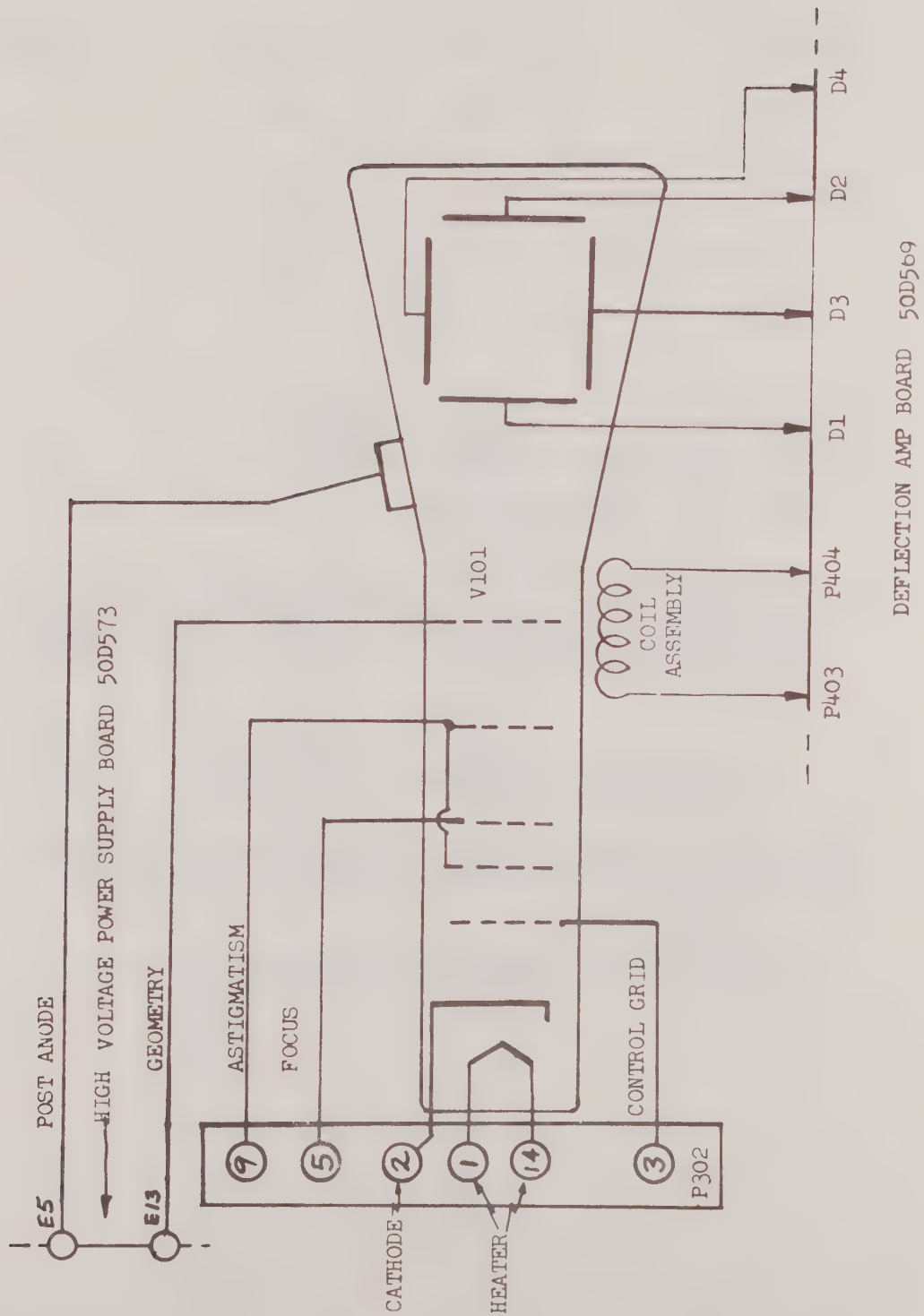


Figure 4-5 Schematic of the CRT Circuit

CHART 4-1

Various CRT Voltage Potentials

CRT Element	Location	Voltage (approx.)
Control Grid (Caution, Do Not Measure)	E6 P302	-1700VDC
Heaters	Pins 14 & 1 P302	6.3VAC
Cathode	E12 (H1 Voltage Board)	-1600VDC
Focus	E9 (H1 Voltage Board)	-1300VDC
Astigmatism	E10 (H1 Voltage Board)	between +150V and -108V
Geometry	E13 (H1 Voltage Board)	+300VDC
Post Anode	E5 (H1 Voltage Board)	+4100VDC
Vertical Plates	D3-D4	35VDC
Horizontal Plates	D1-D2	75VDC

NOTE

Voltage measurements are made with respect to the DC power supply ground.

4.3.3 DEFLECTION AMPLIFIERS. The Horizontal and Vertical circuits are mounted on the same circuit board. The vertical and horizontal board is located in the lower left section of the Display unit (see Reference Schematic 50E618 and Figure 4-6).

4.3.3.1 Horizontal Deflection Amplifier

The purpose of the horizontal deflection amplifier is:

- a. To amplify 5V peak from the sweep generator to approximately 140V peak.
- b. To provide a differential output to drive the Horizontal deflection plates of the CRT.
- c. To provide a Horizontal positioning trace on the CRT.

In the delay or video sync mode the calibrated sweep generator is connected to the input of the horizontal amplifier. Q404 is an emitter follower which drives the emitter coupled differential amplifiers (Q402 and Q403). Emitter follower Q401 is used as a buffer for the horizontal positioning control. As the horizontal positioning control (located in the Timer Unit) is rotated; this changes the bias to the base of the differential amplifier Q402 shifting the position of the trace horizontally on the screen. R402 Horizontal Gain is adjusted so that the gain of Q402 and Q403 are equal to the gain required for proper horizontal deflection on CRT. D1 and D2 are connected directly to the horizontal deflection amplifier section. Horizontal sink bias R403 is adjusted for 28ma current through R401 to assure adequate horizontal deflection, so that a 5.0V peak signal on the input (J402-X) equals more than a 10cm deflection on the CRT. Horizontal trace alignment R411 is used to align the horizontal trace parallel to the internal graticule line. All operating voltages for the Horizontal Deflection Amplifier are obtained from the low voltage power supply board.

4.3.3.1 VERTICAL DEFLECTION AMPLIFIER. (See Reference Schematic 50E618 and Figure 4-7).

The purpose of the vertical deflection amplifier is:

- a. To amplify the video signals from the receiver final vertical input 6.5V peak to approximately 56V peak.

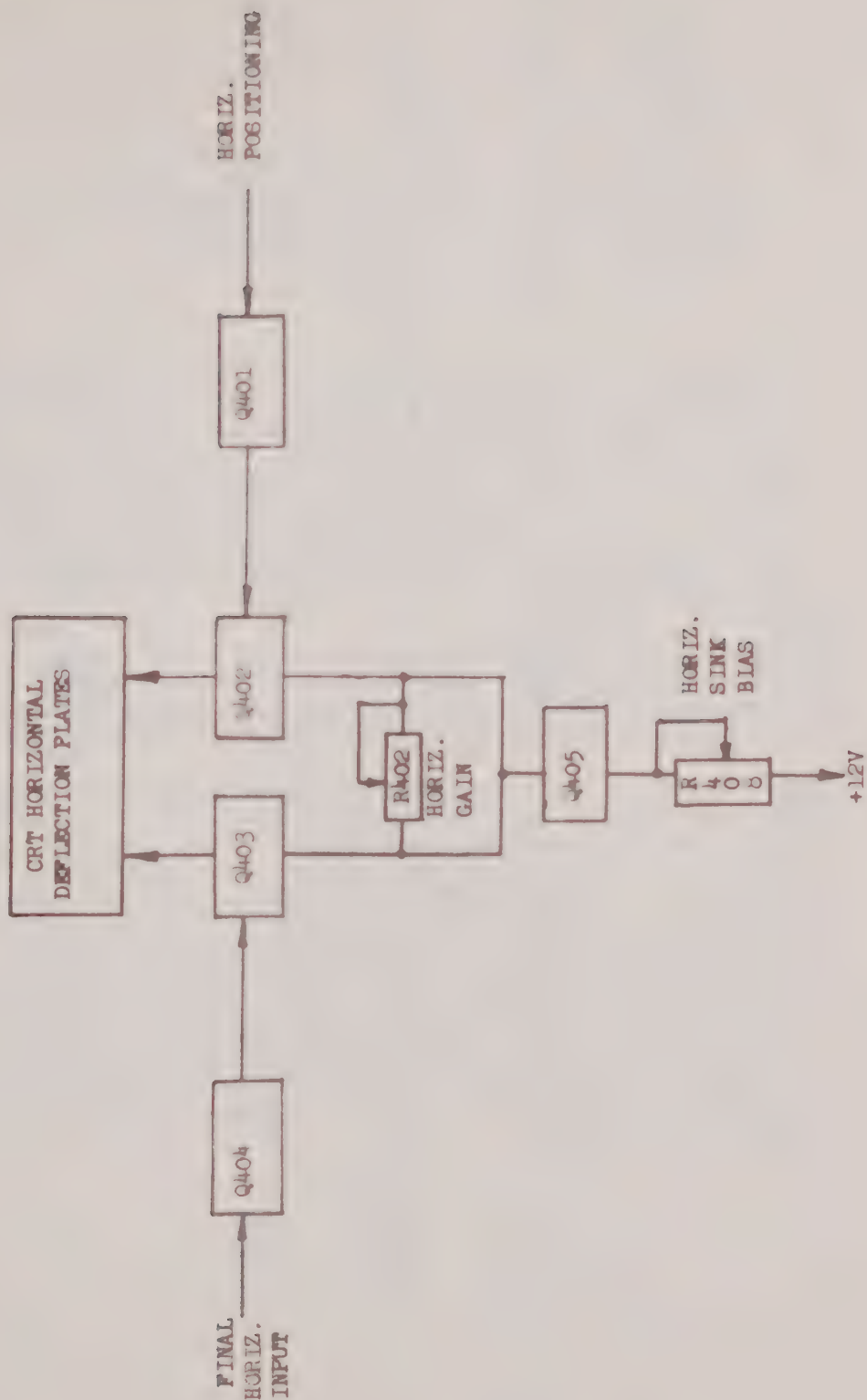


Figure 4-6 Block Diagram of the Horizontal Amplifier Circuit

- b. To provide a differential output to drive the vertical deflection plates of the CRT.
- c. To provide a vertical positioning trace on the CRT.
- d. To provide vertical summing inputs of display marks, steps input, gates input and vertical positioning.
- e. To provide a second trace input.

The differential amplifier Q409 and Q412 drives the output of Q410 and Q411 which are connected to the CRT vertical deflection plates. The final output to the deflection plates are fed at the collectors of Q410 and Q411 (D3 and D4). Vertical gain R443 is adjusted so that the gain of Q410 and Q411 is equal to the required amplitude signals at the collectors for proper vertical deflection on CRT. Vertical sink bias R450 is adjusted for approximately 88ma input collector current thru R419, which will give proper vertical signal deflection.

Display marks, vertical positioning, step and gate inputs (vertical index summing) are various inputs to the emitter follower Q415. The vertical index summing signal or signals are then fed to one side of the differential amplifier base Q412.

Final vertical input to the base of Q409 is a 6.5V peak signal selecting video, RF (waveform 5), DAC (waveform 7) or a combination of video and DAC (waveform 5 and 6) for vertical display. See Figure 4-11 for the various vertical waveform signals. Early sync waveform (2), a positive and negative going signal, is impressed onto the base of Q406 and Q408, acting as a switching device. When the positive signal of waveform (2) is sent to the base of Q406, there is forward biasing of the transistor which will connect Video/RF waveform (5) to the input of J101-8 to final vertical input circuit. When the negative signal of waveform (2) is sent to the base of Q408 the forward biasing of the transistor will connect the Vertical Auxiliary input to the final vertical input circuit. When Q408 is forward biased, Q406 is in reverse bias closing the circuit input to Q406.

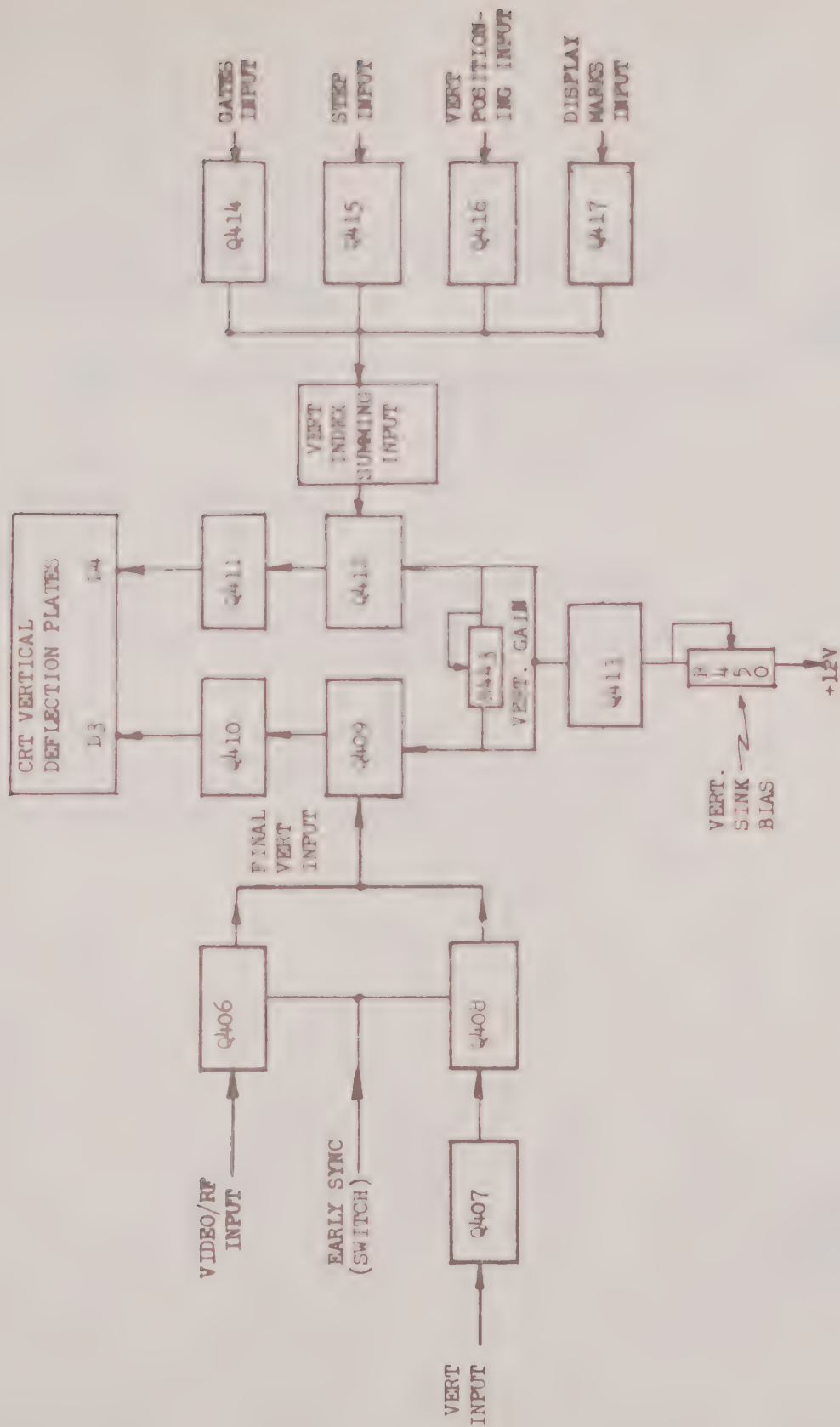


Figure 4-7 Block Diagram of the Vertical Amplifier Circuit

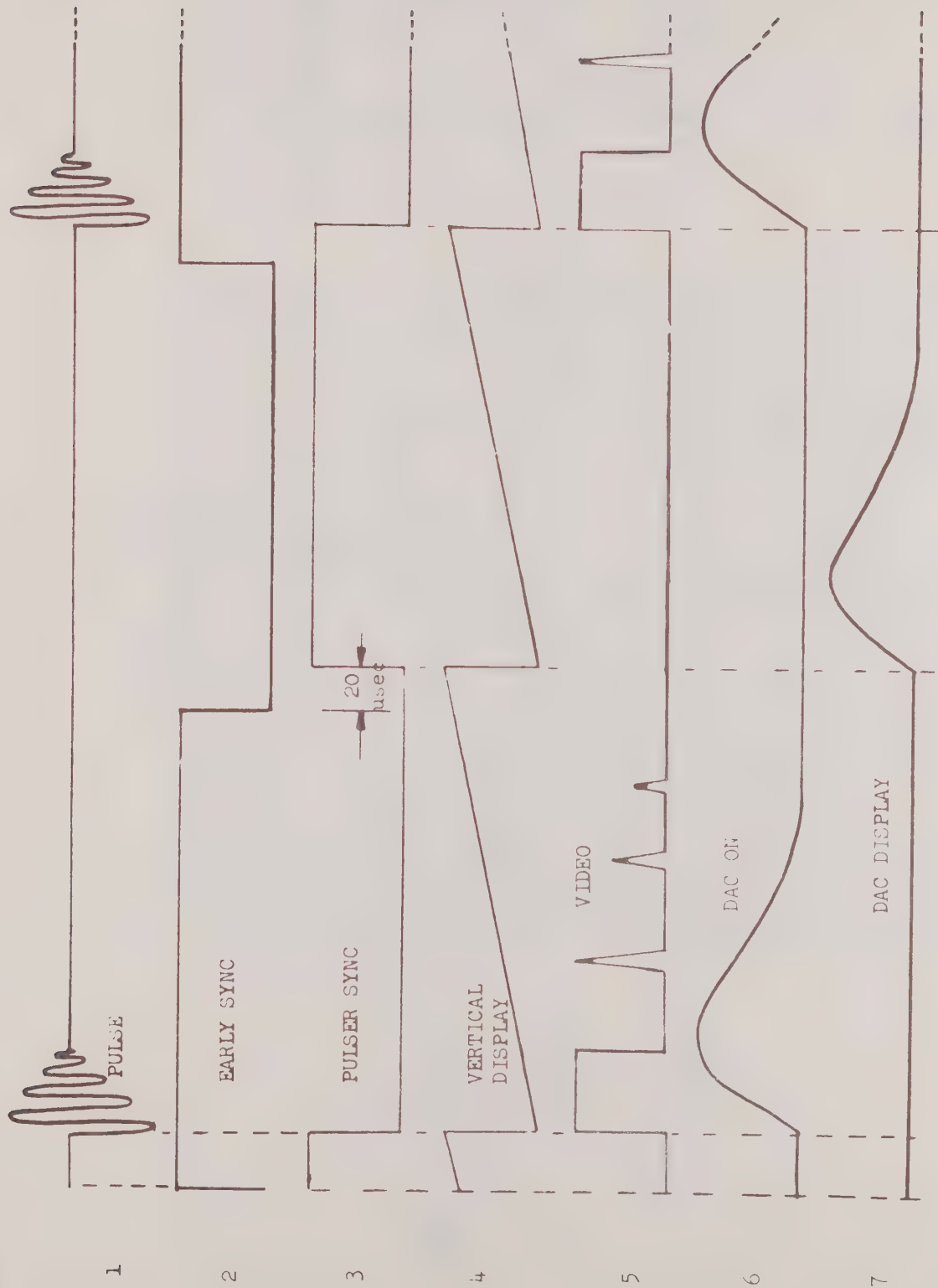


Figure 4-8 Various Waveforms, Pulse, Sync, Vert. Display, Video and DAC

Waveform 6 and 7 - When a distance amplitude correction (DAC) circuit is incorporated in a Pulser/Receiver unit, these two waveforms are displayed on the CRT. Marker or step inputs are also displayed on the CRT.

All operating voltages for the Vertical Deflection amplifier are obtained from the low voltage power supply board.

4.3.4 Interconnection Printed Circuit Board Assembly 50C1370 (See Reference Schematic 50E618).

The purpose of the Interconnect Board is to Tie-in all signals and voltages from the Low Voltage Board, High Voltage Board, Deflection Amplifier Board and Plug-in Circuits (Pulser/Receiver and accessory) to present a display on the Cathode Ray Tube.

The output of the Low Voltage power supply is connected to J201 of the Interconnect Board. The voltages within this board are then distributed to the High Voltage Board, Deflection Amplifier Board, J101, J103, J105 and J106.

CHAPTER 5

MAINTENANCE

5.1 GENERAL

This chapter contains information for use in preventive maintenance, repair, and/or troubleshooting of the UM-771/775 Reflectoscope. There are Troubleshooting and Voltage charts. There are also five (5) photographs at the back section of this chapter which illustrate the UM-771/775 Reflectoscope with covers removed pointing out various components. These figures will be referenced throughout this chapter in connection with various maintenance procedures.

5.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, lubrication, and recalibration. Preventive maintenance performed on a regular basis will help prevent instrument failure and will improve the reliability of this instrument. The severity of the environment which the Reflectoscope is subjected to will determine the frequency of maintenance.

5.2.1 Cleaning the Reflectoscope

The Reflectoscope should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path. The Reflectoscope covers provide protection against dust in the interior of the instrument. Operation without the covers in place will require more frequent cleaning and creates an electrical hazard.

5.2.1.1 Exterior

Loose dust accumulated on the outside of the Reflectoscope can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the controls. Dirt which remains can be removed with a soft cloth dampened in a mild solution of water and detergent.

CAUTION

Do not use any abrasive or solvent on the face of the CRT. Clean the CRT face with a soft, lint-free cloth dampened with denatured alcohol.

5.2.1.2 Air Filter

If air filter becomes dirty, remove and clean filter box with mild soap solution and warm water. After filter box has been dried out, spray a thin coat of Rotron Filtercoat on the outside of the filter box.

5.2.1.3 Interior

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild water and detergent solution. A cotton-tipped applicator is useful for cleaning in narrow spaced or printed circuit.

5.2.2 Lubrication

The reliability of potentiometers, rotary switches and other moving parts can be increased if they are kept properly lubricated. Use a cleaning-type lubricant on shaft bushings, interconnecting plug contacts, and switch contacts. Lubricate switch detents with a heavier grease.

5.2.2.1 Lubrication of the Air Fan

- a. The Mark 4 Muffin Fan has been oiled at the factor to provide ten years of operation at room temperature. If you intend to use your Mark 4 Muffin in ambient temperatures that exceed room temperatures, it is recommended to plan a re-oiling schedule for at least one oiling per year. Special oil and applicators are available as accessory items from Automation Industries, Inc., Sperry Division, Danbury, Connecticut, U.S.A.
 1. Rotron Part No. 19263, Oiler Kit
 2. Rotron Part No. 19263-4, Oiler Kit Refill Bottles
- b. To inject oil into the bearing:
 1. Position the needle at an angle of 45° to the rubber dust cap located at the center of the motor spider.
 2. Pierce the rubber dust cap.
 3. Depress plunger firmly until oil has gone down one calibration line.

4. Hold the dust cap in position and withdraw needle and wipe off excess oil. Oil may be left in the syringe for future use. Be sure that the rubber dust cap remains in place after oiling.

5.2.3 Visual Inspection

The unit should be inspected occasionally for such defects as broken connections, improperly seated transistors, and heat damaged parts.

The remedy for most visible defects is obvious; however, particular care must be taken if heat-damaged parts are located. Overheating is usually only a symptom of trouble. For this reason, it is essential to determine the actual cause of overheating before the heat-damaged parts are replaced; otherwise, the damage may be repeated.

5.3 CHECKOUT, ADJUSTMENT AND CALIBRATION

5.3.1 Power Supply Checkout and Adjustment (See Figure 5-2)

The schematic diagram (50E618) shows the voltage readings which should be obtained at the various power-supply test points. The schematic diagram shows where the voltage test points are physically located. Use "E" numbers on the PC Board to check voltages.

WARNING

Be extremely careful in making measurements with the supply turned on. Voltages dangerous to life are present.

If it becomes necessary to replace any power supply components, the output of the power supply may have to be readjusted. Use the following procedure to insure that the supply is working properly after repair.

- a. Turn the power on and set the front-panel sweep timing and display controls for normal sweep presentation.
- b. Test Equipment
 1. Tektronix 531 with 2 channel plug-in or equivalent.
 2. RCA Senior Volttohmmeter WV-87A, Simpson 270 or equivalent.

CAUTION

Lethal voltages are present; always turn instrument OFF when making temporary connection. Always keep one hand clear when measuring and adjusting controls. Do not touch any of the components or wiring. Ground all instruments and test equipment.

5.3.1.1 Low Voltage Power Supply Checks and Adjustments P. C. Board 50D568(see Figure 5-2).

Remove top and bottom covers of the UM-771/775 Reflectoscope.

NOTE

Do not adjust voltage controls if output voltages fall within stated tolerances.
Use insulated screwdriver whenever possible.

a. +300V Power Supply

1. Check cathode voltage at CR205 and ground. It should read between 225V and 280V.
2. Check +300V power supply at E40 and ground. The voltage should read +300 $\pm$ 5V. Adjust R204 if necessary.
3. Measure with an oscilloscope the peak-to-peak ripple voltage at E15; it should be no greater than 50MV.

b. +150V Power Supply

1. Check cathode voltage at CR207 and ground. The voltage should read between +104V and +116V.
2. Check +150V power supply at E32 and ground. The voltage should read +150V $\pm$ 1.5V. Adjust R209 if necessary.
3. Measure with an oscilloscope the peak-to-peak ripple voltage at E18; it should be no greater than 25MV.

c. -108V Power Supply

1. Check voltage from anode CR208 to cathode of CR208. Reading should be between -76V and -84V.
2. Check -108V power supply at E34 and ground. The voltage should read -108V $\pm$ 2V. Adjust R124 if necessary.
3. Measure with an oscilloscope the peak-to-peak ripple voltage at E34 and ground. It should be no greater than 15MV.

d. +75V Power Supply

1. Check +75V power supply at E33 and ground. The voltage reading should be between +73 and +77V. Voltage adjustment is available for the +75V.
2. Measure with an oscilloscope the peak-to-peak ripple voltage at E33 and ground; it should be no greater than 50MV.

NOTE

The +75V and -108V power supply section should be checked first and should be within stated tolerances before +12V supply can be checked.

e. +12V Power Supply

1. Check +12V power supply E35 and ground. The voltage reading should be +12V ±.1V. Adjust R220 if necessary.
2. Measure with an oscilloscope the peak-to-peak ripple voltage at E35 and ground; it should be no greater than 30MV.

f. -12V Power Supply

1. Check -12V power supply at E37 and ground. The voltage reading should be -12V ±.1V. Adjust R225 if necessary.
2. Measure with an oscilloscope the peak-to-peak ripple voltage at E37 and ground; it should be no greater than 30MV.

TABLE 5-1

Summary of the Low Voltage Power Supply

Voltage	Test Point	Adjust	Ripple Less Than
+300V <u>+5V</u>	E40	R204	50MV
+150V <u>+1.5V</u>	E32	R209	25MV
-108V <u>+2V</u>	E34	R214	15MV
+75V <u>+2V</u>	E33	None	50MV
+12V <u>±</u> .1V	E35	R220	30MV
-12V <u>±</u> .1V	E37	R225	30MV

5.3.1.2 High Voltage Power Supply, CRT Checks and Adjustments
P.C. Board Assembly 50D573 (see Figure 5-3).

CAUTION

High Voltages are present. Do not touch any of the components or wiring. Always keep one hand in the clear when making adjustments and temporary connections (connecting test lead, etc.).

- a. Check if intensity and focus of the CRT Sweep presentation are within specifications:
 1. Vary Intensity control between upper and lower limit. The intensity should extinguish and come in to full brilliance.
 2. Check CRT focus; the entire sweep should remain within focus.
- b. If the preceding steps (1 and 2) are not within specification, perform the following high voltage adjustment (steps c through k).
- c. With the power in the OFF position, remove Q307. By removing Q307, the high voltage circuit is inoperative, low voltage is operative.
- d. Apply power. Measure the plate voltage (red dot) of VR305. Voltage reading should indicate between +159V and +169V.
- e. Measure the cathode voltage of CR304. Voltage reading should indicate between +1.5V and +2.5V.
- f. Measure the plate voltage of VR308 with the scope. The scope reading should be 100V to 110V unblanking signal. The point of the unblanking signal should be variable from +37V $\pm$ 5V to 120V $\pm$ 10V measured by adjusting the intensity control R312.
- g. Connect scope to collector of Q301. Remove AC power from instrument and apply power.

CAUTION

High Voltage will be present.

- h. Measure the period and amplitude of the waveform appearing at this point. A period of 60u μ sec $\pm$ 20u μ sec for one complete cycle and a peak-to-peak amplitude should be between 16V and 18V.
- i. Adjust the High Voltage Control (R-332) to the threshold of trace visibility on the screen. Rotate Intensity control to maximum intensity and check if CRT blooming occurs, decrease the High Voltage Control to eliminate blooming effect.
- j. Using the RCA Senior VTVM and High Voltage probe measure the HIGH VOLTAGE at test point E5. VTVM reading should be between +3.9KV and +4.4KV.
- k. Measure voltage at E12. VTVM reading should be between -1540V and -1710V.
- l. Adjust for proper geometry. This control can adjust for over and under compensation of geometry control.

NOTE

Geometry is a rectangular raster centered on the face of the tube. The raster edges will not deviate from straight lines on the left and right edges or top and bottom of the CRT.

- m. Adjust focus control for the sharpest presentation over entire sweep range.
- n. Adjust astigmatism control for proper astigmatism. Sweep line should remain in focus over entire sweep length.
- o. Repeat steps m and n for the best results.
- p. Observe sweep trace on CRT, rotate intensity control (upper and lower limit). Sweep trace should turn on and off.
- q. Disconnect all test leads and normalize instrument.

5.3.2 Horizontal and Vertical Deflection Amplifiers and Timesharing Circuits. P.C. Board Assembly 50D569.

5.3.2.1 The following Table 5-2 lists the proper signal levels for the Horizontal and Vertical Amplifier inputs.

TABLE 5-2

Horizontal and Vertical Amplifier Inputs

Pin	Signal	Function
12	-12V	Supply
13	6.7V P-P/Vert Aux Input	Video Signal
14	+150V	Supply
15	6.7 P-P	Video Signal
16	0V	Gates Input
17	Grd	Grd
18	+12/-12 Square Wave	Early Sync
19	+12V	Supply
20	6.7V P-P/Vert Aux Input	Time Shared Output
21	5V P-P (Sawtooth)	Final Horizontal Input
22	+75V	Supply
23	Variable from	
24	-.5 to +4V	Horizontal Position
25	+.5 to +8V	Vert Aux Input
26	-1 to +8V	Vert Positioning

5.3.2.2 Horizontal and Vertical amplifier adjustments and checks (See Figure 5-4).

- a. Check the current on the +75 Volt line. Adjust if necessary R450 (vertical sync bias) for 88 ma. This is a FACTORY ADJUSTMENT.
- b. Check the current on the 150 volt line. Adjust if necessary R403 (Horizontal sync bias for 28 ma. This is a FACTORY ADJUSTMENT.
- c. Adjust the horizontal gain control R402 to give full screen deflection. Make sure the horizontal positioning is properly adjusted and able to center the horizontal deflection.
- d. Adjust the vertical gain control R443 to give 3" vertical deflection. Make sure the vertical positioning control is properly adjusted and able to center the vertical deflection.
- e. Check to see the positioning control for vertical aux. input positions alternate trace.
- f. Measure the voltage on J404. Adjust R411. Make sure this control can vary the voltage on J404 from -12V to +12V.
- g. Disconnect all leads and normalize instrument.

5.4 TROUBLESHOOTING

5.4.1 Troubleshooting is the process by which the cause of a malfunction is discovered by means of a systematic procedure. Most malfunctions which will occur in the UM-771/775 Reflectoscope will be electrical in nature. First, a thorough knowledge and understanding of the Reflectoscope instrument is a prerequisite. Second, suspected malfunctions such as: intensity is set to low or a switch is in the wrong place.

5.4.2 The following will help to localize a particular trouble to a single assembly:

- a. Troubleshooting Charts (5-1 thru 5-12)
- b. Voltage Charts (5-13 and 5-14)
- c. Photographs (Figure 5-1 thru 5-5 Component Identification)

WARNING

Never connect or disconnect Transistor Plug-in units or P.C. Boards when UM Reflectoscope is in the "ON" position.

Always begin troubleshooting by making a visual inspection of the four P.C. Boards and associated circuits. Check for any loose or burned components. Check for any loose wire connection, connectors not mating correctly, and any other related source of trouble. If the particular trouble can not be localized, replace the three printed board assemblies, by process of elimination.

CAUTION

Avoid shorting supply voltage or components when measuring voltages or waveforms.

5.4.3 Test and Associated Equipment

The following test and associated equipment is required for checking the Reflectoscope.

- a. Servistension Style 50C549.
- b. Tektronix 531 or equivalent recently calibrated.
- c. Simpson Model 260, recently calibrated. High Voltage probe.

CAUTION

Personal Safety Warning. Lethal Voltages are present. Always turn instrument OFF when changing components. Always keep one hand in the clear when making temporary connections (connecting test leads, etc.).

- 5.4.4 All electrical components are accessible for replacement from the P.C. Boards and sub-assembly. The Low Voltage and the High Voltage P.C. Board assemblies are hinged and swing up in position for easier maintenance. (See figure 5-1)

The instrument P.C. boards are double etched circuit boards and electrical components are hole-through mounted. Before the component is removed from the P.C. board special consideration should be followed:

- a. Use low heat soldering iron (35 to 55 watts and less than 700°F usable temperature).
- b. Small diameter solder (60/40). Clean the surrounding area thoroughly after Rosin solder is used.

NOTE

Do not use Acid core solder.

- c. Care should be taken to avoid damage to the circuit board by applying too much heat or solder. Avoid ripping the printed board conductor leads.
- d. If small diodes are to be removed or reinstalled use a heat sink between the soldering iron and the component lead.
- e. If the component is burnt, clip off the leads, flush to the P.C. board and remove unclipped leads from opposite side of P.C. board.
- f. Clear solder hole on the P.C. board.
- g. Reinstall component leads and clip to proper length.
- h. Resolder component again avoiding excess heat.

TROUBLESHOOTING CHARTS

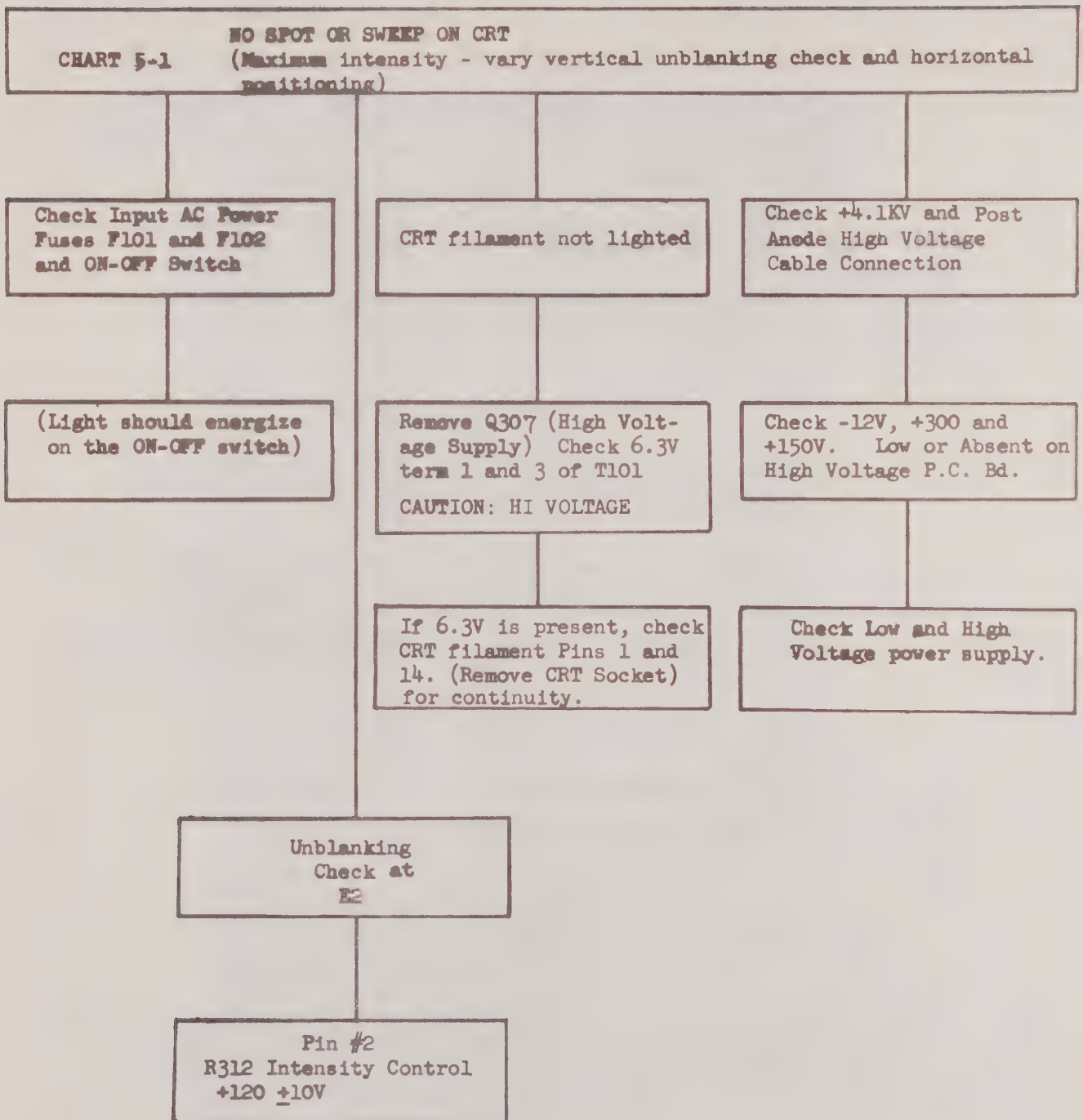


CHART 5-2

SWEEP CANNOT BE FOCUSED

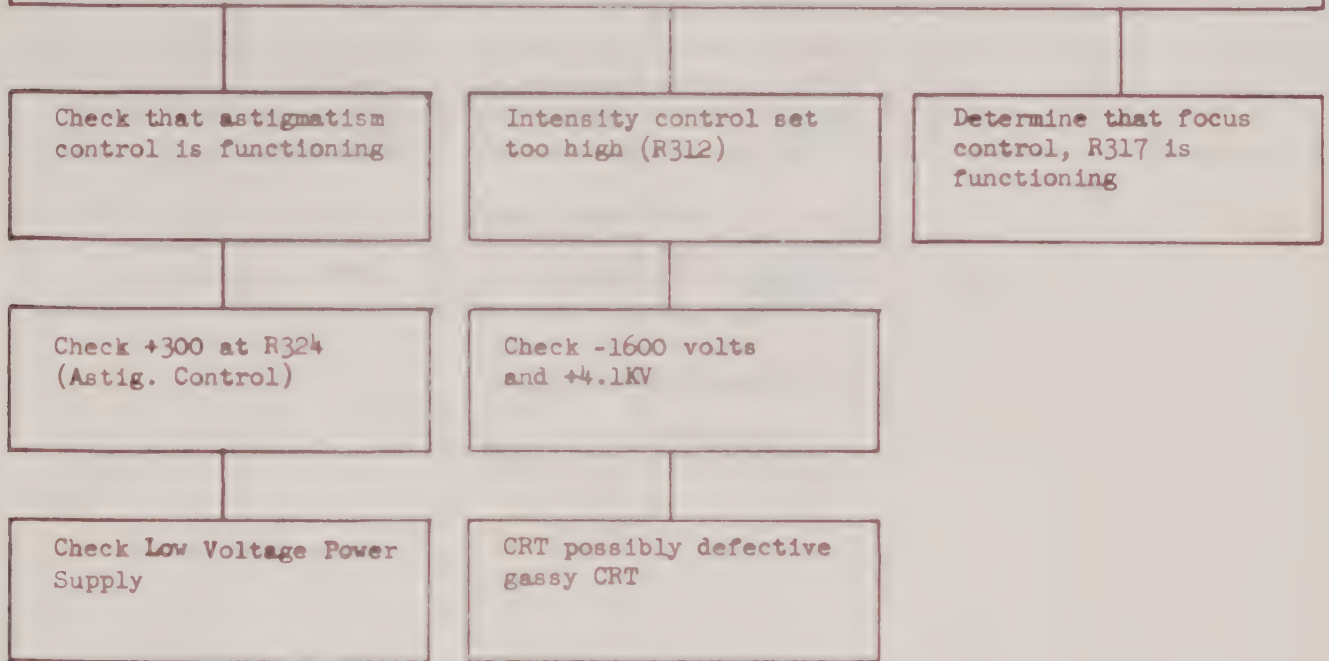
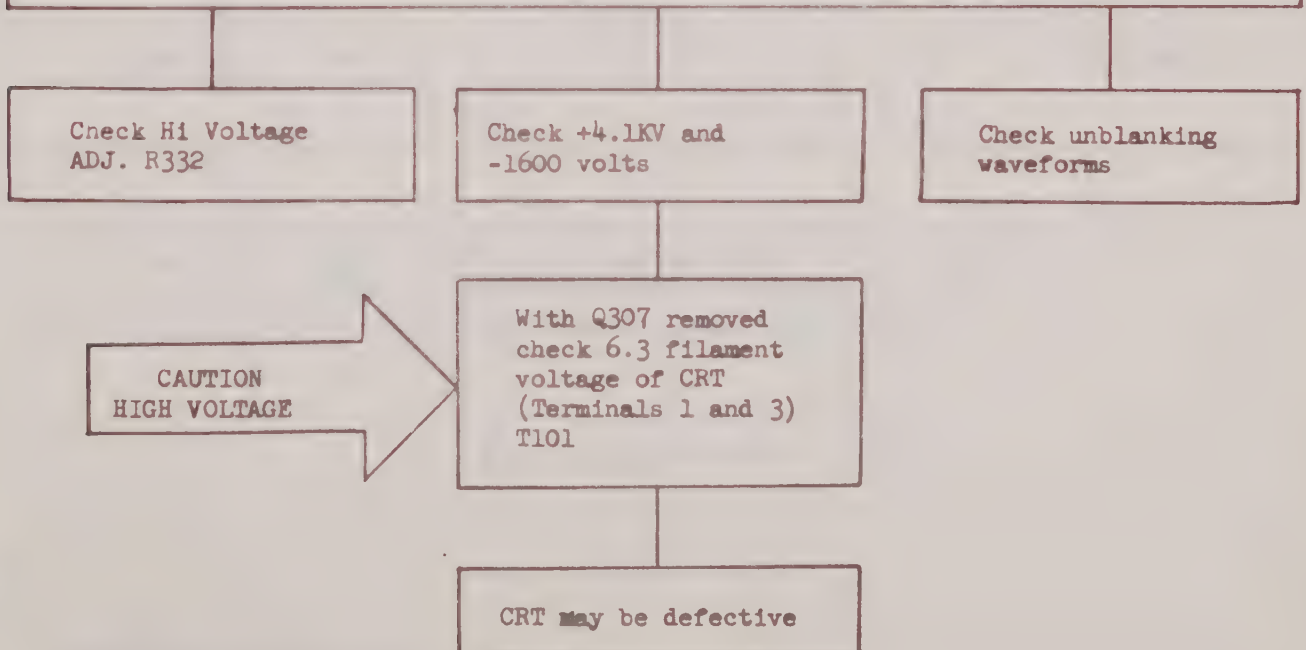


CHART 5-3

SWEEP TOO DIM
(Maximum Intensity) Proper Focusing



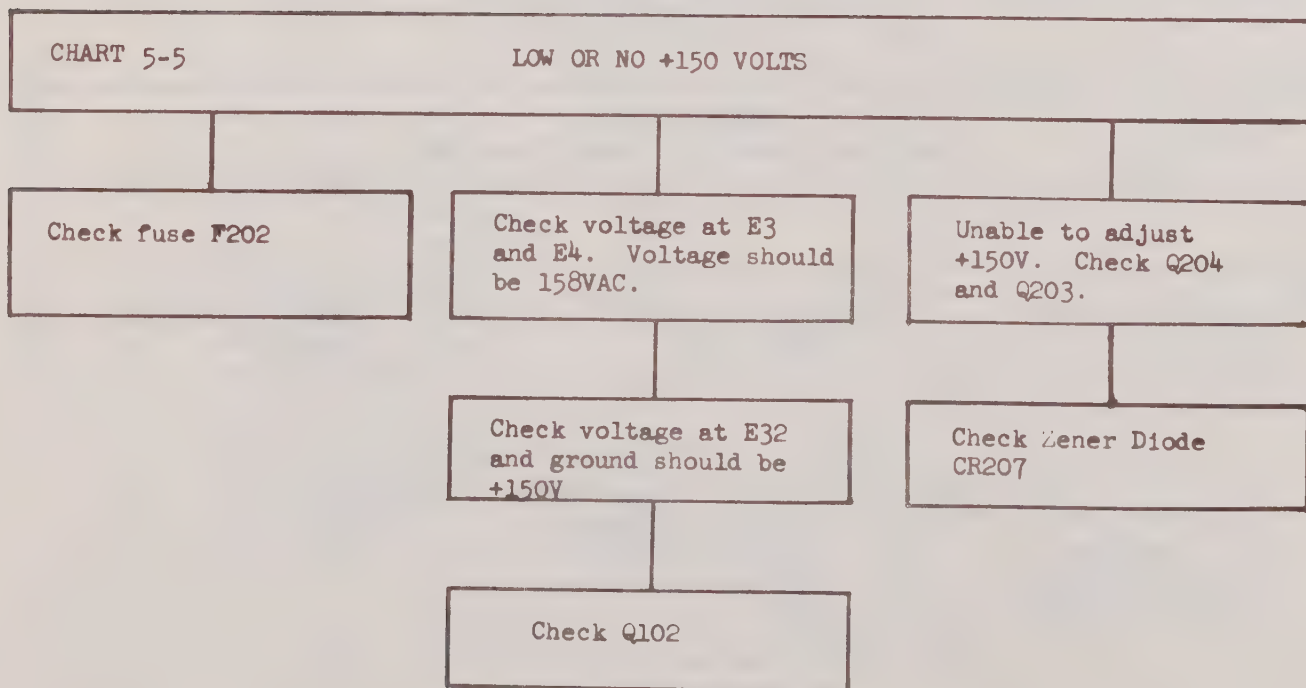
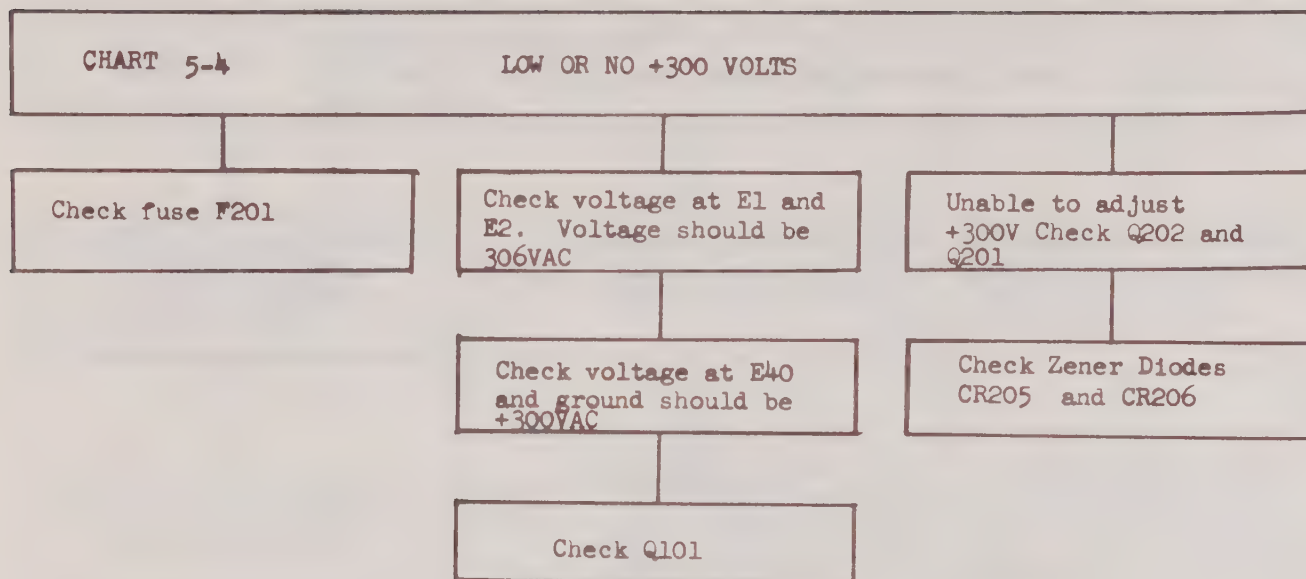


CHART 5-6

LOW OR NO -108 VOLTS

Check Fuse F203

Check voltage at E5
and E6. Should be 117VAC

Unable to adjust -108V.
Check Q205 and Q206

Check voltage at E34 and
ground should be -108V

Check Zener Diode
CR208

Test OK

CHART 5-7

LOW OR NO +75 VOLTS

Check Fuse F204

Check voltage at E7
and E8. Should be
86VAC.

Check Q104 and Q207

Check voltage at E33
and ground should be
+75V.

Check Zener Diode
CR227.

CHART 5-8

LOW OR NO +12V (No Adjust)

Check F205

Check voltage at E9 and E11. Should be 34VAC

Unable to Adjust +12V
Check Q208, Q209 & Q210

Check voltage at E35 and ground should be +12VDC

Check Zener Diode CR209

Check Q105.

CHART 5-9

LOW OR NO -12V (No Adjust)

Check F206

Check voltage at E9 and E11. Should be 34VAC.

Unable to adjust -12V.
Check Q214, Q216 & Q217.

Check voltage at E37 and ground should be -12VDC

Check Zener Diode CR214

Check Q106

CHART 5-10

NO +4100V OR -1600V

Check low voltage input -12V

No +4.1KV

No -1600 at E12 on H1 Voltage Bd.

Check inverter Q301 and Q302.

Check T301

Check H1 Voltage Diode CR307

Check H1 Voltage Diodes CR301 and CR302

Check Q305, 306 and 307

CHART 5-11

VERTICAL LINE* OR
HALF THE HORIZONTAL DEFLECTION ON CRT**

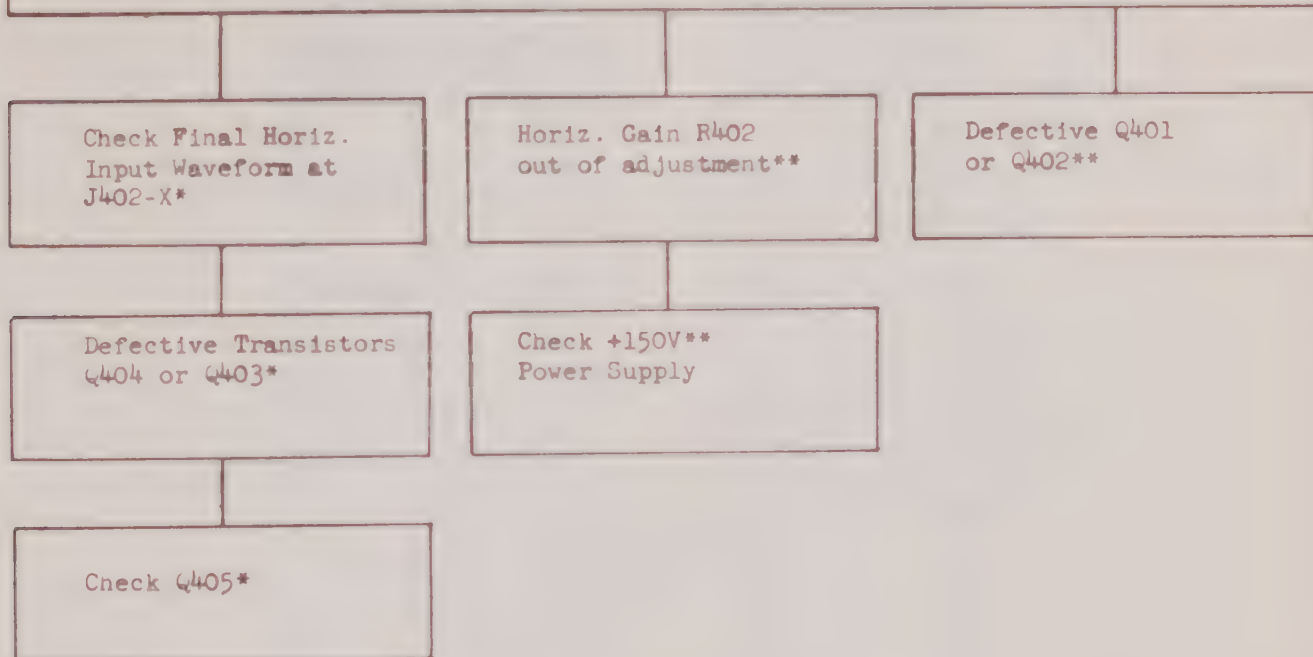
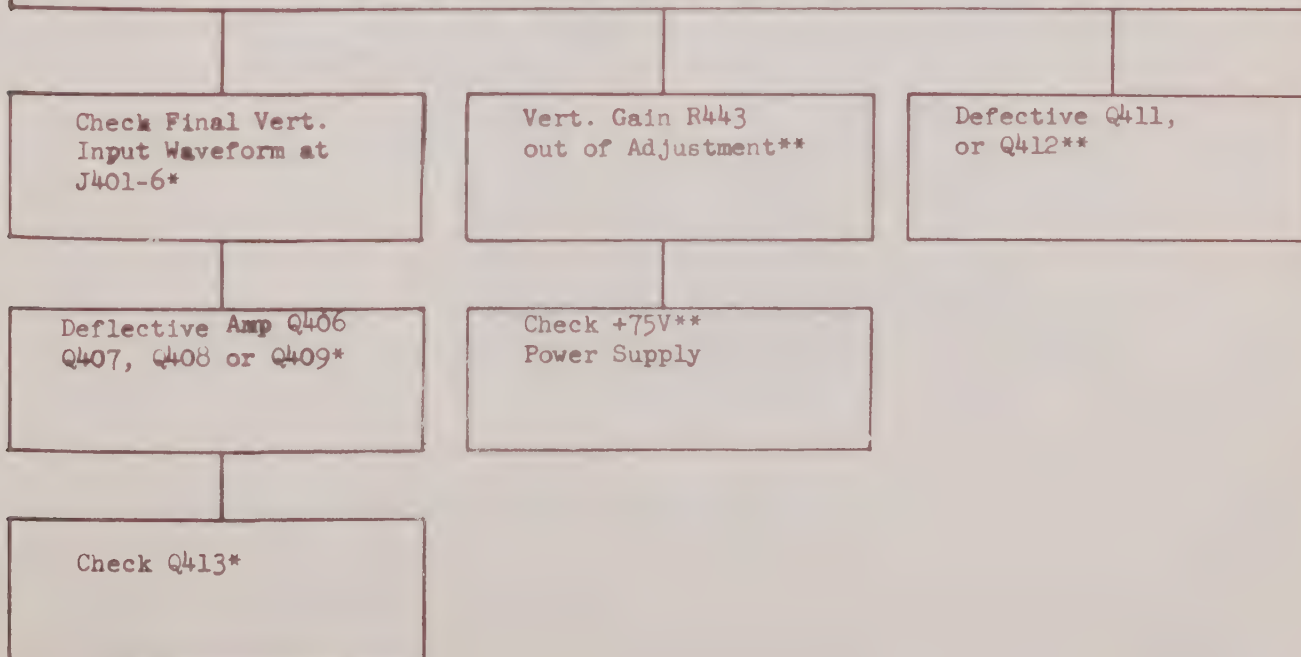


CHART 5-12

HORIZONTAL LINE* OR
HALF THE VERTICAL DEFLECTION ON CRT**



VOLTAGE CHARTS

CHART 5-13

Low Voltage Power Supply Board No. 505500

Test Point	Voltage	Test Point	Voltage
E1	0V	E1	0V
E2	0V	E2	0V
E3	0V	E3	0V
E4	0V	E4	0V
E5	0V	E5	0V
E6	0V	E6	0V
E7	0V	E7	0V
E8	0V	E8	0V
E9	0V	E9	0V
E10	0V	E10	0V
E11	0V	E11	0V
E12	0V	E12	0V
E13	0V	E13	0V
E14	0V	E14	0V
E15	0V	E15	0V
E16	0V	E16	0V
E17	0V	E17	0V
E18	0V	E18	0V
E19	0V	E19	0V
E20	0V	E20	0V
E21	0V	E21	0V
E22	0V	E22	0V
E23	0V	E23	0V
E24	0V	E24	0V
E25	0V	E25	0V
E26	0V	E26	0V
E27	0V	E27	0V
E28	0V	E28	0V
E29	0V	E29	0V
E30	0V	E30	0V
E31	0V	E31	0V
E32	0V	E32	0V
E33	0V	E33	0V
E34	0V	E34	0V
E35	0V	E35	0V
E36	0V	E36	0V
E37	0V	E37	0V
E38	0V	E38	0V
E39	0V	E39	0V
E40	0V	E40	0V
E41	0V	E41	0V
E42	0V	E42	0V
E43	0V	E43	0V
E44	0V	E44	0V
E45	0V	E45	0V
E46	0V	E46	0V
E47	0V	E47	0V
E48	0V	E48	0V
E49	0V	E49	0V
E50	0V	E50	0V
E51	0V	E51	0V
E52	0V	E52	0V
E53	0V	E53	0V
E54	0V	E54	0V
E55	0V	E55	0V
E56	0V	E56	0V
E57	0V	E57	0V
E58	0V	E58	0V
E59	0V	E59	0V
E60	0V	E60	0V
E61	0V	E61	0V
E62	0V	E62	0V
E63	0V	E63	0V
E64	0V	E64	0V
E65	0V	E65	0V
E66	0V	E66	0V
E67	0V	E67	0V
E68	0V	E68	0V
E69	0V	E69	0V
E70	0V	E70	0V
E71	0V	E71	0V
E72	0V	E72	0V
E73	0V	E73	0V
E74	0V	E74	0V
E75	0V	E75	0V
E76	0V	E76	0V
E77	0V	E77	0V
E78	0V	E78	0V
E79	0V	E79	0V
E80	0V	E80	0V
E81	0V	E81	0V
E82	0V	E82	0V
E83	0V	E83	0V
E84	0V	E84	0V
E85	0V	E85	0V
E86	0V	E86	0V
E87	0V	E87	0V
E88	0V	E88	0V
E89	0V	E89	0V
E90	0V	E90	0V
E91	0V	E91	0V
E92	0V	E92	0V
E93	0V	E93	0V
E94	0V	E94	0V
E95	0V	E95	0V
E96	0V	E96	0V
E97	0V	E97	0V
E98	0V	E98	0V
E99	0V	E99	0V
E100	0V	E100	0V

NOTE

1. Use Simpson Model 360 or equivalent and Hi Voltage probe.
2. Voltage measurements are made with respect to the DC power supply ground.

CAUTION

Personal Safety Warning: Lethal Voltages are present.

CHART 5-14

High Voltage Power
Supply and Unblanking
Board No. 50D573

Test Point	Voltage
E3	-12V
E4	+150V
E5	+4,100V
E7	-108V
E8	-1580V (Approx.)
(Caution: Do not measure)	
E9	-1300V
E12	-1600V
E13	+300VDC (Approx.)
E19	+300V

Deflection Amp.
Board No. 50D569

Test Point	Voltage
E1	6.3VAC
E2	
E5	-12V
E7	+150V
E12	GND
E15	+12V
E25	+75V

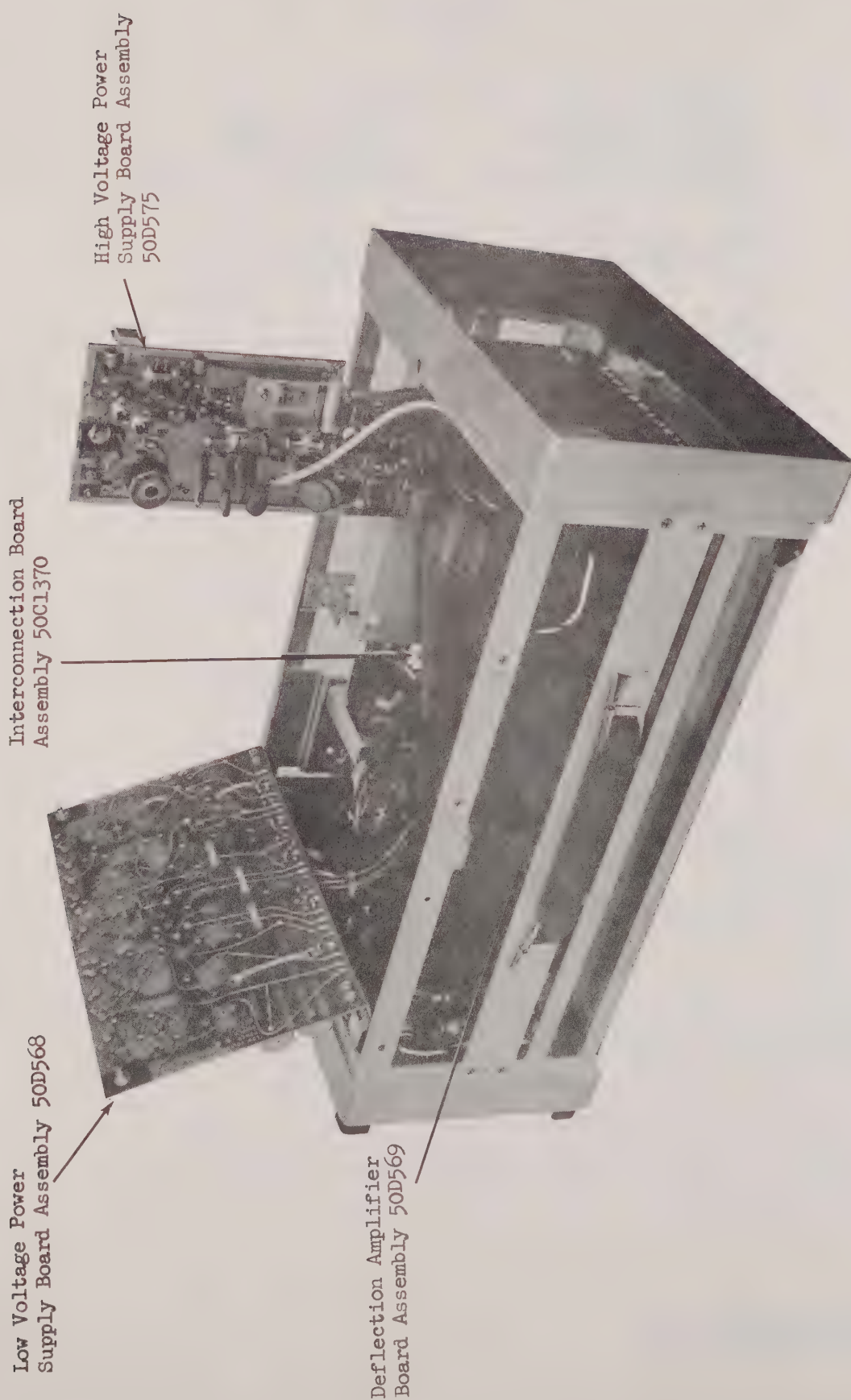


Figure 5-1 The UM-775 is illustrated with the covers removed, showing various P.C. Board Assembly Locations. The P.C. Board Assembly Locations for the UM-771 are the same as in the UM-775 Reflectoscope.

Voltage Charts (Cont'd)

CHART 5-14

High Voltage Power
Supply and Unblanking
Board No. 50D573

Test Point	Voltage
E3	-12V
E4	+150V
E5	+4,100V
E7	-108V
E8	-1500V (Approx.)
(Caution: Do not measure)	
E9	-1300V
E12	-1600V
E13	+300VDC (Approx.)
E19	+300V

Deflection Amp.
Board No. 50D569

Test Point	Voltage
E1	6.3VAC
E2	
E5	-12V
E7	+150V
E14	GND
E15	+12V
E25	+75V

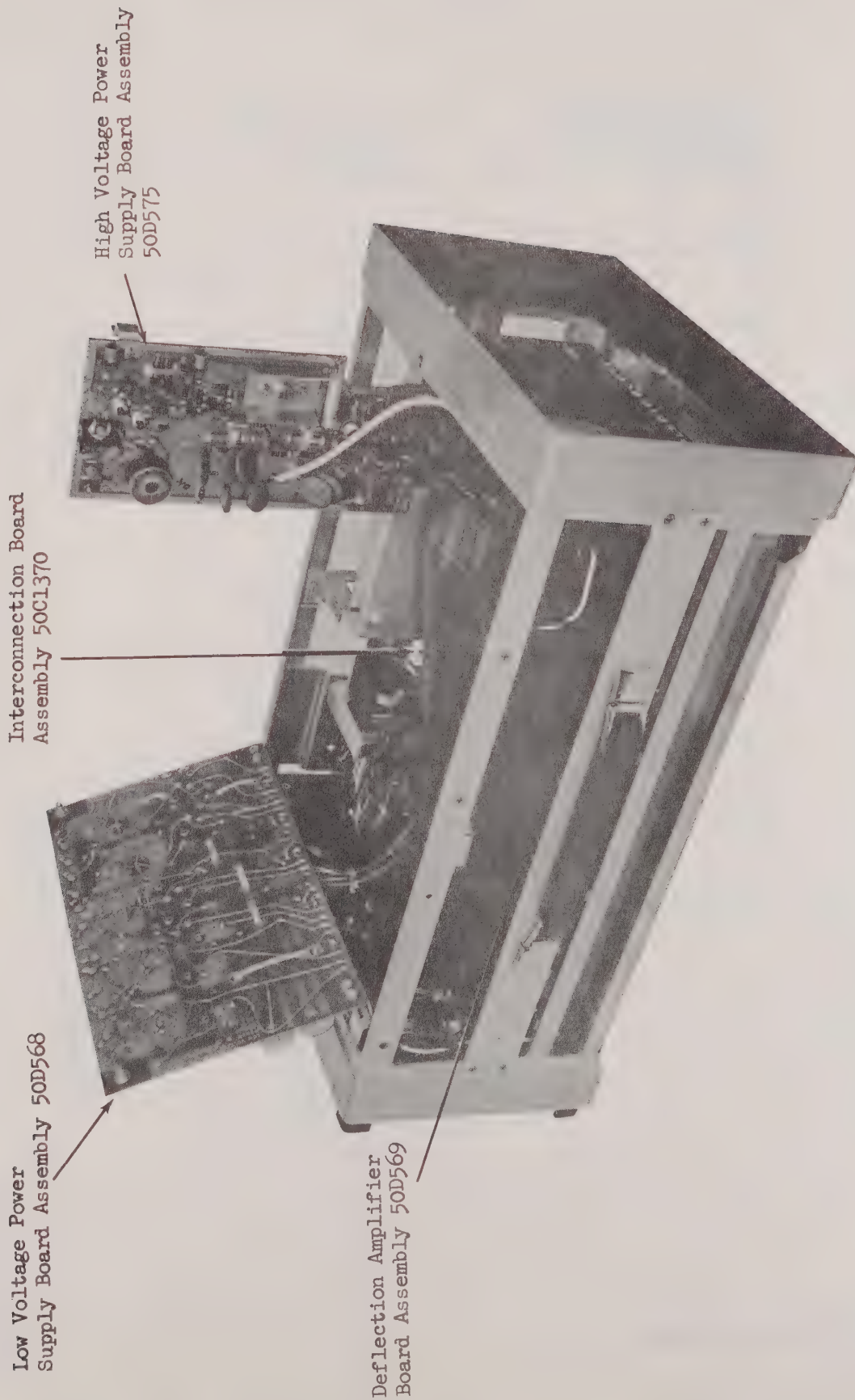


Figure 5-1 The UM-775 is illustrated with the covers removed, showing various P.C. Board Assembly Locations. The P.C. Board Assembly Locations for the UM-771 are the same as in the UM-775 Reflectoscope.

E (Number)
TEST POINTS

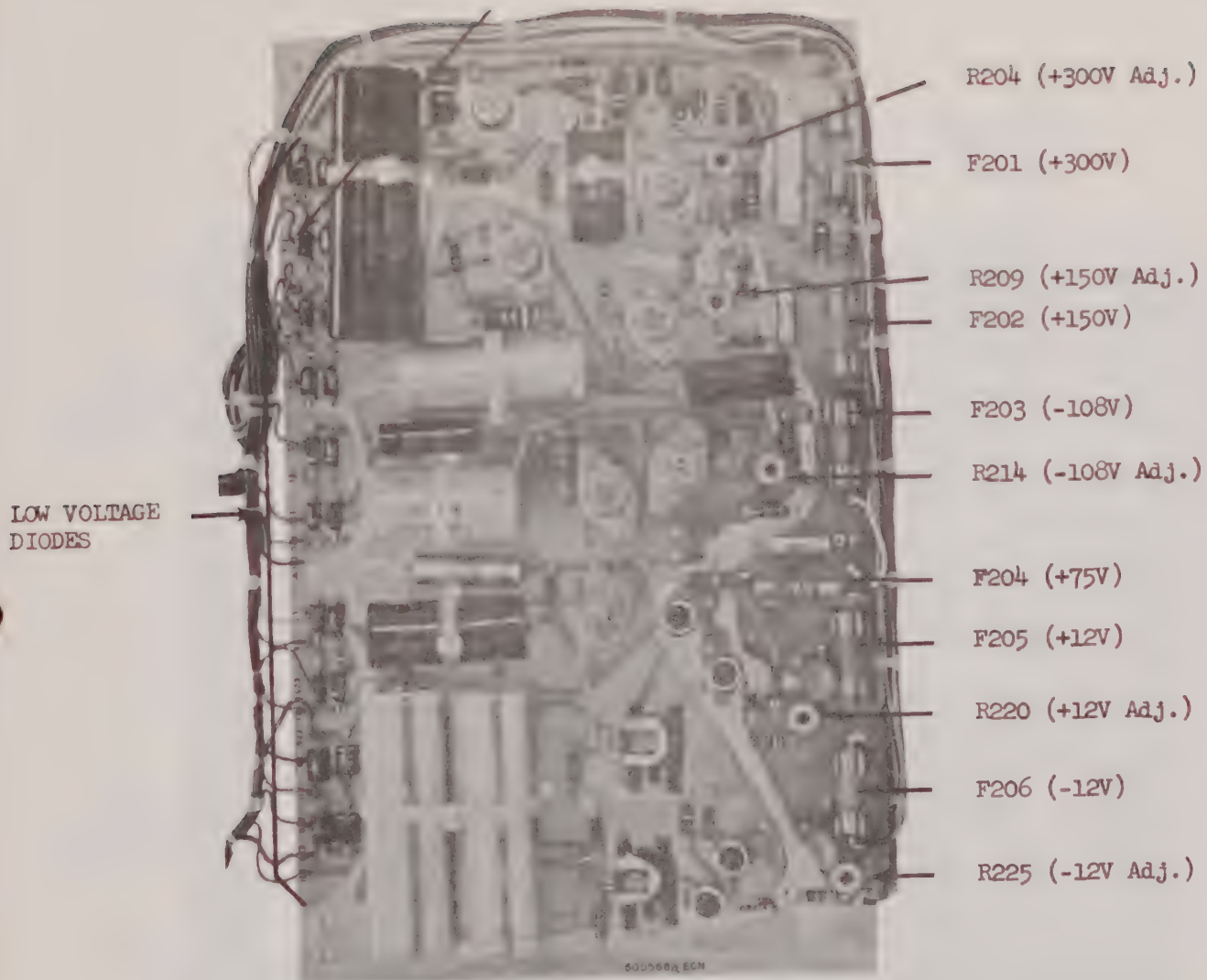
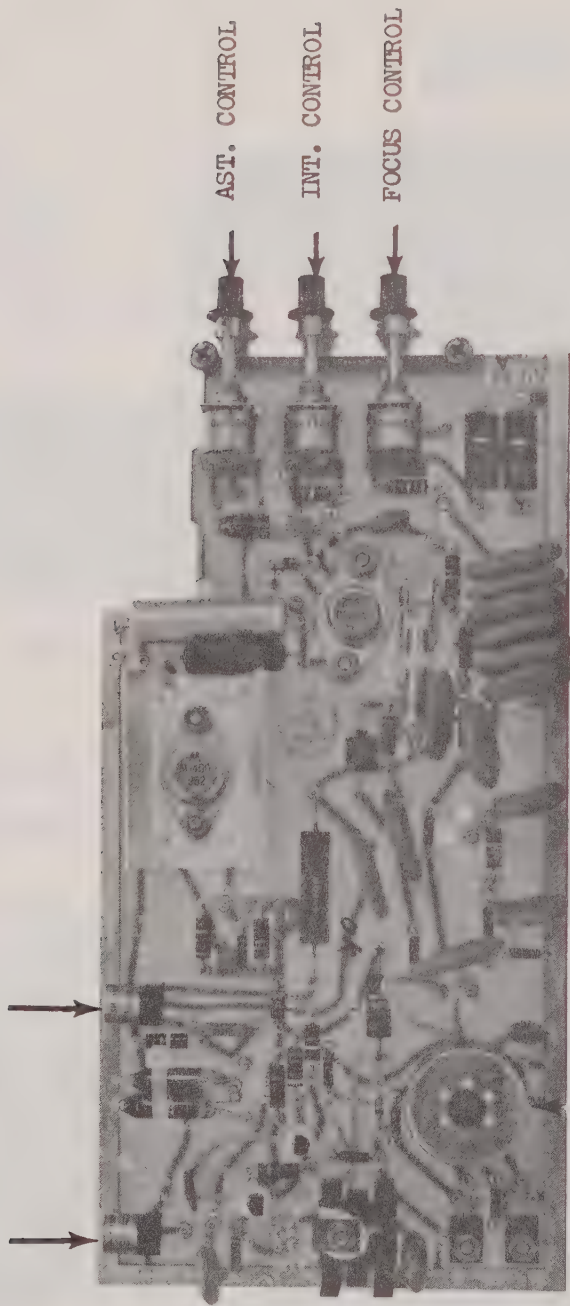


Figure 5-2 Various Components and Test Points in
the Low Voltage Power Supply Board
Ass'y 50D568

GEOM
ADJHIGH VOLT
ADJ

T301

Figure 5-3 Various Components in the High Voltage Power Supply and Unblanking Board Ass'y 50D575

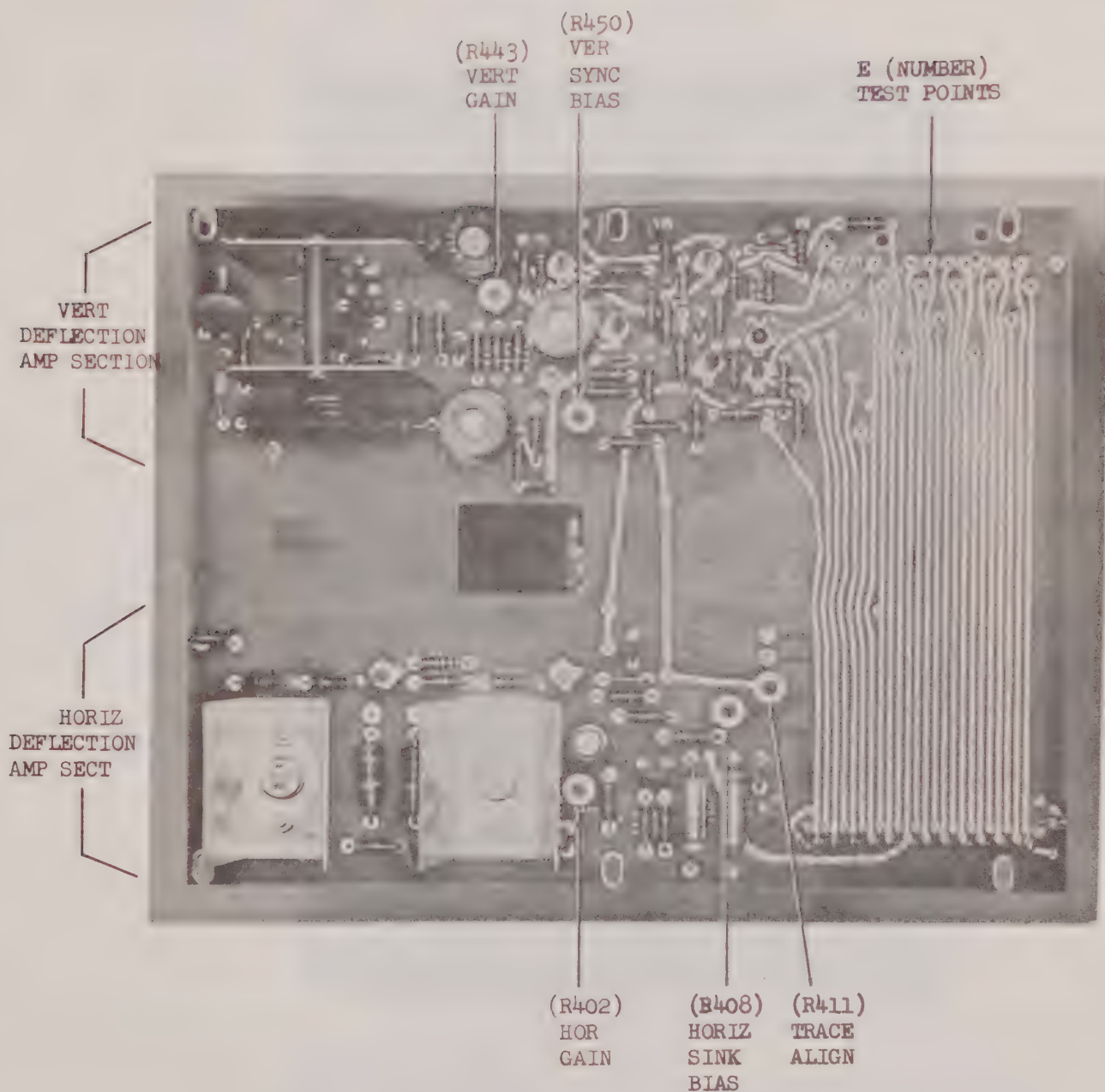


Figure 5-4

Various Components and Test Points in
the Deflection Amplifier Board Ass'y 50D569

(J103) REAR PLUG

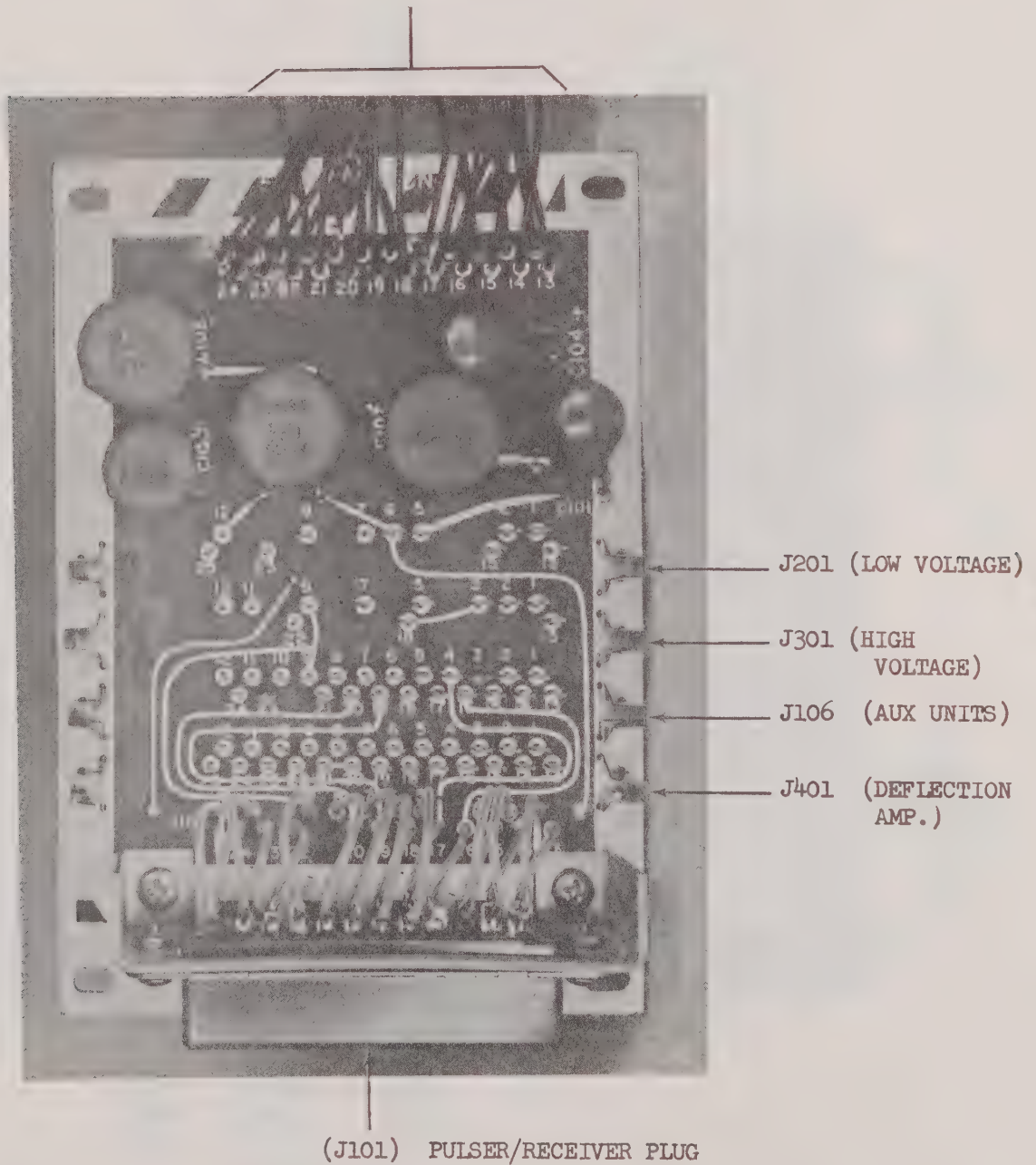


Figure 5-5 Various Components and Test Points in the Interconnect Board Ass'y 50C1370

5.4.5 Removal and replacement of the CRT (UM-771 and UM-775 Reflectoscope).

- a. To remove the CRT, proceed as follows:
- b. Remove both the top and bottom covers on Reflectoscope.

WARNING

To prevent possible personal injury, always wear goggles and gloves.

Use extreme care in handling the CRT.

Discharge Post Anode Lead to Ground.

- c. Unscrew and lift up High Voltage Power Supply P.C. Board Assemble.
- d. Carefully remove Post Anode Lead and discharge both Post Anode Lead and CRT connector.
- e. Remove round CRT protective plate in rear of Reflectoscope.
- f. Carefully remove CRT Socket.
- g. Remove all color coded CRT center leads.
- h. Remove four inside bezel screws on CRT shield.
- i. Place one hand on the front of CRT and with the other hand, slide the CRT with the magnetic shield forward and then out of the Reflectoscope.
- j. Loosen shield clamp at the neck of the CRT and remove CRT.
- k. Remove rubber cushion on face of CRT.
- l. To replace the CRT, reverse the procedure.

NOTE

After the CRT has been installed, be sure to line up the internal horizontal Graticule parallel with the front of the bezel.

- m. After replacing the CRT, check the following adjustments. High Voltage Power Supply, paragraph 5.3.1.2, and horizontal-vertical amplifier, paragraph 5.3.2.2.

APPENDIX A

GLOSSARY

ACOUSTIC ATTENUATION	The loss of energy at an ultrasonic wave-front as it passes through a material. Usually measured in db/cm.
ACOUSTIC IMPEDANCE	The product of the density and the velocity of a material. An important factor governing the propagation of waves at material boundaries.
AMPLIFIER	Any circuit which increases the amplitude of an electronic signal.
AMPLITUDE	The height of a displayed signal. An indication of the amount of reflected energy.
ANGLE BEAM TESTING	Ultrasonic testing using a transducer oriented to the test surface at any angle other than perpendicular.
ANGLE OF INCIDENCE	That angle between the direction of the ultrasonic beam and a line perpendicular to the test material surface at the point of entry.
ASTIGMATISM CONTROL	Control for focusing the outer edges of the sweep on a cathode ray tube.
BACK SURFACE	That surface of the test material farthest from the transducer.
C.R.T. (CATHODE RAY TUBE)	Display tube in the UM Reflectoscope
COAX (COAXIAL CABLE)	A special type of electrical cable with one conductor inside of and insulated from the other.
COMPRESSIONAL WAVE	In ultrasonics, synonymous with longitudinal wave.
COUPLANT	A liquid or semi-liquid used in contact testing to facilitate the transmission of wave movement from the transducer face to the entry surface of the test material. Typically a couplant is water or an oil of some type.

GLOSSARY (Cont'd)

CRITICAL ANGLES	The incident angles which produce complete mode conversion in a particular material.
CRYSTAL	The active element in an ultrasonic transducer. Usually a material with piezoelectric qualities.
DAC (DISTANCE AMPLITUDE CORRECTION)	The circuit which increases the gain of the receiver as time progresses (as the ultrasound penetrates deeper into the test material).
DAMPING MATERIAL	The material used in transducer construction to back the crystal. Its purpose is to reduce crystal ringing.
DEFLECTION PLATES	The vertical and horizontal electrodes within a cathode ray tube which produce the trace by moving the spot on the screen.
DELAYED SYNC	The synchronizing signal occurring at the time the sweep starts; the point of time at the left of the screen.
DISCONTINUITY	A general term applied to any interruption of an ultrasonic wave movement within a test material. Usually the term refers to a defect.
EARLY SYNC	The synchronizing signal generated first from which all other signals are timed; times zero.
FOCAL LENGTH	The distance between the transducer face and the focal point.
FOCAL POINT	The converging point of an ultrasonic beam. The point of maximum intensity.
FREQUENCY	The number of completed wave cycles per unit time.
FRONT SURFACE	That surface of the test material closer to the transducer.

GLOSSARY (Cont'd)

GAIN	Amplification
GAIN CONTROL	Amplification control
INITIAL PULSE	The first signal displayed on the sweep. It represents the energy produced by the pulser and in contact testing may be coincident with the test surface reflection.
INTERFACE	The boundary between two closely proximate materials. In immersion testing the term is often used to identify the signal returned from the entry surface of the test material.
LONGITUDINAL MODE	A form of ultrasonic vibration wherein the particle motion within the test material is parallel to the direction of propagation.
LONGITUDINAL WAVES	Longitudinal waves are characterized by particle displacement in the direction of wave propagation. Also called compressional waves from the pattern of alternating particle compression and rarefaction produced by the wave movement.
MAIN BANG	The transmitted pulse of ultrasound.
MODE CONVERSION	The changing from one mode of wave propagation to another which is a function of the incident angle and the material velocity.
PIEZOELECTRIC EFFECT	The expansion and contraction of certain materials when activated with a voltage, or the eliciting of a voltage in the same material by mechanical strain. Piezoelectric materials such as quartz, lithium sulfate, barium titanate (among others) are used as the active element (crystal) of ultrasonic transducers.

GLOSSARY (Cont'd)

PIP	A pulse displayed on the cathode ray tube.
PULSE	An electrical signal which rises and falls very sharply.
REFLECTION	A change in wave direction caused by the wave striking an acoustic boundary. The angle of reflection will equal the angle of incidence.
REFRACTION	Refraction is the change in velocity and direction of wave movement when passing through two dissimilar mediums due to the change of impedance.
RESOLUTION	The ability to distinguish clearly between closely proximate reflections.
RINGING	Excessive vibrating of a transducer crystal after electric excitation.
SENSITIVITY	Ultrasonic sensitivity is the ability to detect small reflecters in a test material.
SHEAR MODE	A form of ultrasonic vibration wherein the particle motion within the test material is perpendicular to the direction of propagation.
SHEAR WAVES	Ultrasonic waves whose particle displacement is mainly perpendicular to the direction of movement. Also termed transverse waves.
SNELL'S LAW	Used to calculate refracted angles when an ultrasonic beam passes from one medium into another. Longitudinal waves: $\frac{\sin\phi_1}{\sin\phi_L} = \frac{V_{L1}}{V_{L2}}$ where ϕ_1 = angle of incidence ϕ_L = angle of longitudinal refraction V_{L1} = velocity of longitudinal waves in the 1st medium

GLOSSARY (Cont'd)

SNELL's LAW (Cont'd)

VL2 = velocity of longitudinal waves
in 2nd medium

Shear waves:

$$\frac{\sin \phi_1}{\sin \phi_s} = \frac{VS1}{VS2}$$

where ϕ_1 = angle of incidence

ϕ_s = angle of shear refraction

VS1 = velocity of shear waves in
1st medium

VS2 = velocity of shear waves in
2nd medium

SWEEP

A line on a cathode ray tube caused by a spot moving or "sweeping" across the screen.

SYNC or SYNC PULSE

An electronic synchronizing signal used for initiating an action.

TRACE

The picture on the cathode ray tube.

TRANSDUCER (Crystal or Search Unit)

A device which transforms energy from one form to another. In this case, from high frequency electrical energy to high frequency mechanical energy and vice versa.

ULTRASOUND

Inaudible sound with a frequency greater than 20,000 cycles per second.

VELOCITY

The speed at which an ultrasonic pulse travels through a given medium.

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

GLOSSARY (Cont'd)

WATER PATH

In immersion testing, the distance between the transducer face to the entry surface of the test material.

WAVEFORM

A graph plotting voltage versus time.

WAVELENGTH

The length of one complete wave as measured from any two points in the same phase.

APPENDIX B
PRINCIPLES OF ULTRASONIC INSPECTION

B1.0 Introduction:

The purpose of this section is to present a brief introduction to the basic concepts upon which ultrasonic inspection is based as well as to familiarize the test equipment operator with typical test procedures.

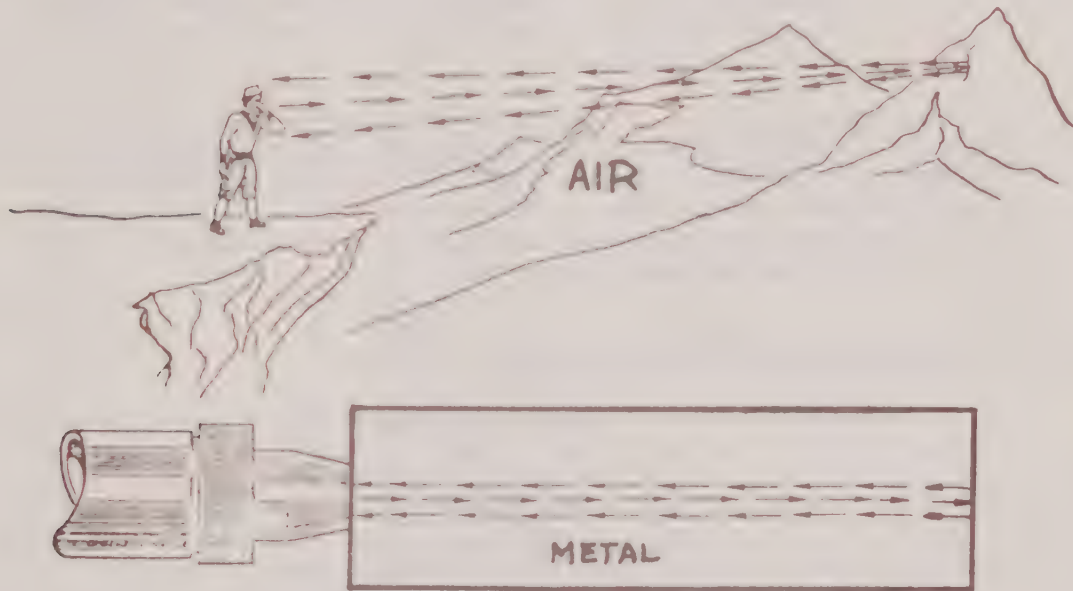


Figure B-1

B1.1 Basic Concepts

B1.1.1 Ultrasonic Waves

The term ultrasonic refers to all vibrational or pressure waves above the frequency of 20,000 cycles per second. Most pressure waves below the frequency of 20,000 c.p.s. are within the normal audible range. The frequencies employed in ultrasonic inspection are far beyond the upper limits of the audible threshold, normally ranging from 0.5 to 25 megacycles (500,000 to 25,000,000 c.p.s.).

Ultrasonic waves have a number of important characteristics which make them useful for inspection purposes:

1. Although they are rapidly attenuated in gases, they will travel relatively long distances through liquids and solids.
2. They tend to travel in straight well-defined beams.

3. The velocity at which a specific type of ultrasonic wave will travel remains **constant through a given medium**.
4. They will change their mode of vibration under certain conditions as at the interfaces of materials having different physical properties; specifically, the density and elasticity of the materials are to some degree reflected from the surfaces of materials and from discontinuities within the material.

These characteristics of ultrasonic waves make them extremely useful in nondestructive flaw inspection. With proper instrumentation for propagating the waves through the test material and analysing their movement, ultrasonic waves will provide the test operator with very specific information regarding the composition of the material under test.

B1.1.2 The Generation of Ultrasonic Waves

Ultrasonic waves are generated by applying an electric pulse to an energy converter called a transducer. This is accomplished by producing a pulse of the desired frequency at a precise time, then converting the pulse into ultrasonic vibrations by means of a piezoelectric crystal. The crystal is actuated for a controllable period of time (usually 1 or 2 microseconds) resulting in a short burst of ultrasonic vibrational waves. This transformation of electrical energy into mechanical energy is the characteristic of piezoelectric materials. When an electric pressure or voltage is applied across a piezoelectric material, its thickness will vary as the frequency of the applied voltage. Conversely, if mechanical pressure is applied to the material, it will generate a small voltage of the same frequency as the applied mechanical vibration. An ultrasonic transducer, then, is essentially a crystal composed of some piezoelectric material which alternately converts electric voltage into mechanical vibrations and then mechanical vibrations into an electric voltage. The resultant output of the transducer is a continuing series of short bursts. Study Figure B-2.

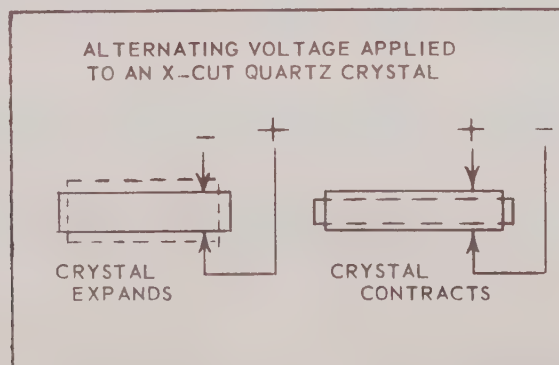


Figure B-2 Generation of Ultrasonic Vibrations

Common piezoelectric materials used for transducer crystals are quartz, lithium sulphate, and some of the polarized ceramics.

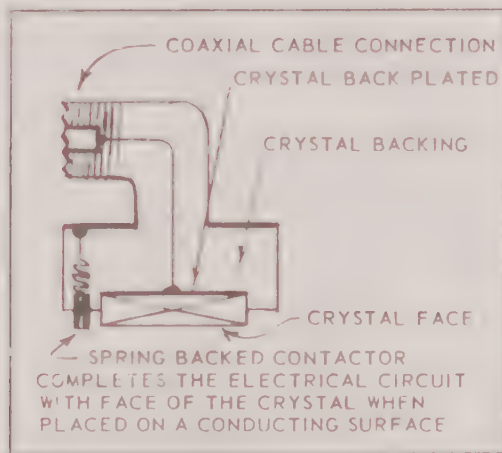


Figure B-3 Typical Search Unit

B1.1.3 Couplant

The actual movement of a transducer is infinitesimal; it is often described as acceleration without motion. To transmit such a small amount of energy into a material, it is necessary to use a couplant, typically water, glycerine, oil, or grease. The sole purpose of the couplant is to provide an acoustically good medium for the passage of ultrasonic vibrations from the transducer crystal to the test material.

In immersion testing, both the transducer and the test material are submerged in a couplant; usually, water with a wetting agent and an anti-corrosion agent added.

In contact testing, a thin couplant film, typically, an oil, is used between the transducer face and the material. Sperry couplants 50A4084, 50A4085, and 50A4086 are excellent all around cou-

plants which work well on rough, vertical, or overhead surfaces, and up to temperatures of 1000°F.

B1.1.4 Ultrasonic Reflection

An ultrasonic wave is reflected whenever a change occurs in the medium which is supporting the wave. The behavior of an ultrasonic pulse can be compared to a beam of light travelling through space and being reflected from a number of mirrors. The path travelled and the return of the beam to its source depends upon the angles **at which it impinges upon** the reflecting surfaces, as well as the number and location of these surfaces. (Figure B-4)

Ultrasonic reflections occur whenever the elastic properties of the medium change; hence, inclusions, cracks, porosity, and voids as well as the surfaces of a part cause reflections. Since the wave cross section is usually larger than most internal flaws, the amplitude or amount of reflection gives an indication of the relative size of the defect.

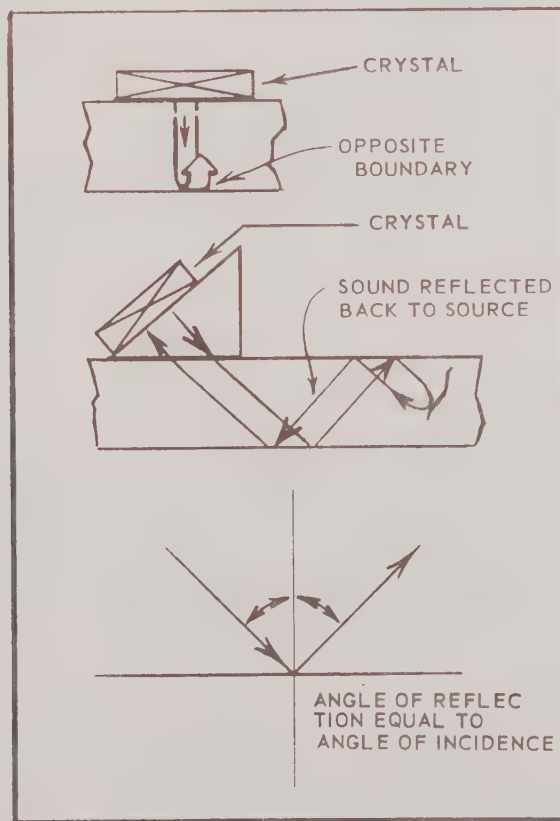


Figure B-4 Reflection of the Ultrasonic Beam

When an ultrasonic wave encounters an interface or second medium, energy is reflected in accordance with the rule, "The angle of reflection is equal to the angle of incidence."

The amount of energy reflected rather than transmitted from one wave supporting medium to another depends on the lack of acoustical similarity between the two media. Since the elastic property of air differs widely from that of any solid, cracks and voids provide 100% reflection.

B1.1.5 Ultrasonic Refraction

Ultrasonic waves are refracted when they pass from one medium to another at an angle other than normal, that is, other than perpendicular.

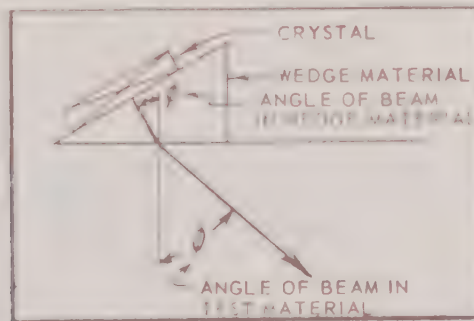


Figure B-5 Refraction of the Ultrasonic Beam

Simply stated, refraction is a change in the angle of wave propagation caused by a change in the acoustic properties of two dissimilar mediums. Refraction of the ultrasonic beam when passing at an angle from one material to another is comparable to the refraction of a light beam when passing through two dissimilar mediums (for example: The apparent displacement of an object in water from its actual position, when viewed at any angle other than normal to the water surface).

B1.1.6 Modes of Ultrasonic Propagation

There are several modes of ultrasonic wave propagation. The two most commonly used in flaw detection are longitudinal waves and shear waves. In more limited use are surface waves and lamb waves.

- a. Longitudinal waves: When ultrasonic waves pass into a material at an angle perpendicular to the material surface, the wave

propagation will be longitudinal. The particle movement within the material will be along the same direction as the wave direction. The waves are compression waves as are audible sound waves.

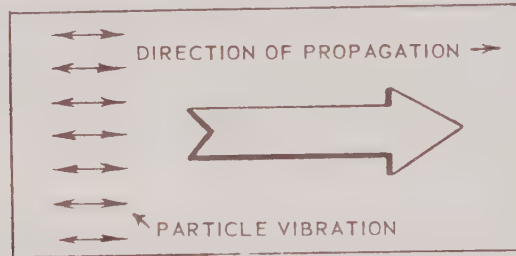


Figure B-6 Longitudinal Waves

- b. Shear waves: When ultrasonic waves enter a material at an angle other than perpendicular, particle displacement motion becomes increasingly transverse to the direction of wave movement. As the angle of incidence increases, there is an increase in "mode conversion" from longitudinal to shear waves. An angle called the 1st critical angle will be reached when longitudinal waves are no longer propagated and only shear waves will be passing through the material. The main factor to be remembered in working with shear waves is that the velocity of a shear wave is approximately one half that of a longitudinal wave.

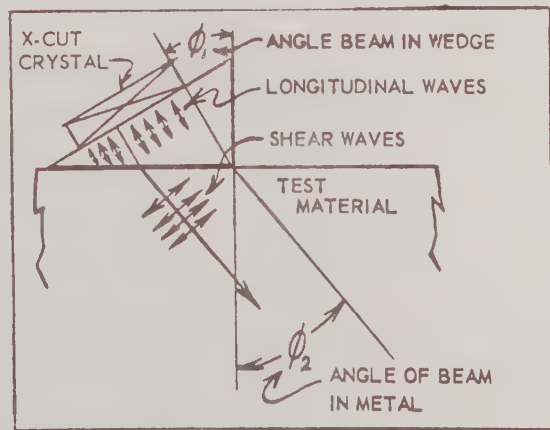
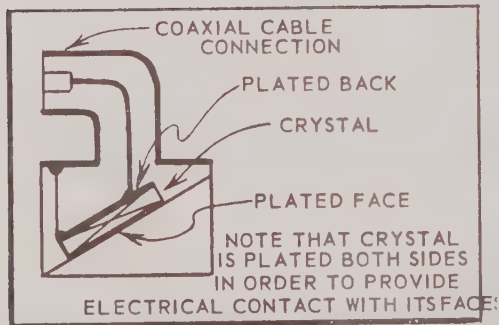


Figure B-7 Angle Beam Search Unit Figure B-8 Generating Shear Waves in Metals

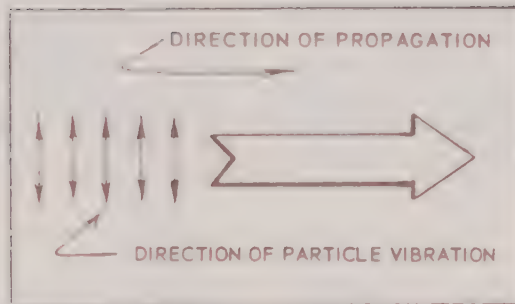


Figure B-9 Shear Waves

- c. Surface waves: If the incident angle is increased further, the second critical angle will be reached when all waves propagated are "surface waves." The term is descriptive: the waves are confined to a narrow region on and just below the surface. The particle displacement of the wave motion follows an elliptical orbit in which the major axis of the ellipse is perpendicular to the surface and the minor axis is parallel to the direction of propagation.

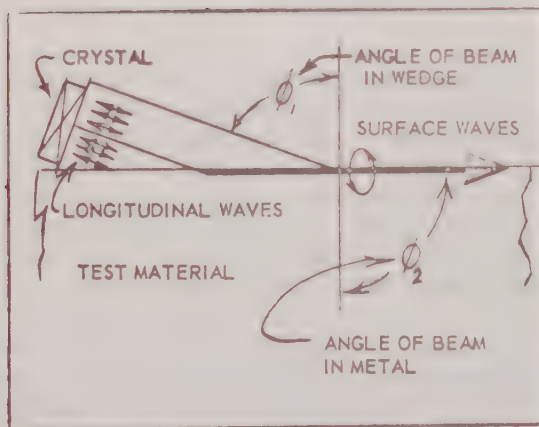


Figure B-10 Generating Surface Waves

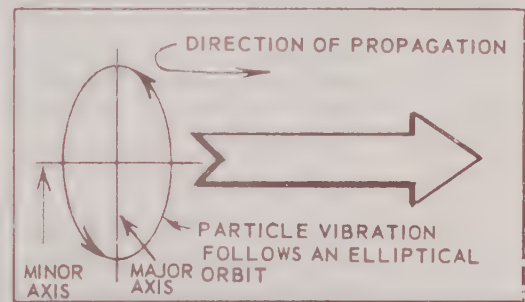


Figure B-11 Surface Waves

Surface waves will travel along smooth rounded contours, but are reflected at abrupt edges. (Figure B-11)

- d. Lamb waves: In thin sheet material or thin walled tubing, a type of wave called the "lamb wave" can be propagated. This is possible only when the thickness of the material is approximately comparable to the wavelength of the waves propagated. Lamb waves can exist in two types and many possible modes. The particle motion of the two types, symmetrical and asymmetrical, are illustrated in Figure B-12.

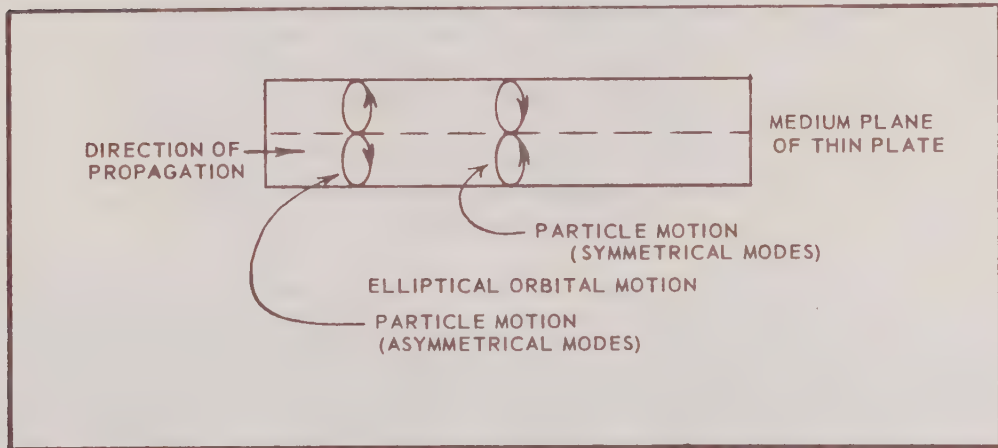


Figure B-12 Particle Motion

Bl.1.7 Ultrasonic Flaw Detection

Ultrasonic flaw detection is accomplished by positioning a transducer in such a position that the desired wave mode will be generated in the test material. The energy passes from the transducer, through the couplant, is partially reflected from the entry surface, passes through the material and is reflected from the rear surface (if the surfaces are parallel). If a discontinuity exists between the surfaces, an echo will be reflected from it as well. Since the velocity of the wave motion remains constant throughout the material, the time difference between entering the material and its reflection from the far surface can be used to establish the distance traveled. With the material boundaries established, the depth of discontinuity can be readily established by measuring the time (distance) from its echo to either the front or back reflections. The amount of energy returned by reflection from the discontinuity will give an indication both of its size and orientation .

Bl.1.7.1 Instrumentation (Figure B-13)

The basic instrumentation necessary to transmit and receive ultra-

sonic pulses consists of a pulse generator, a transducer, a receiver, and a pulse display unit.

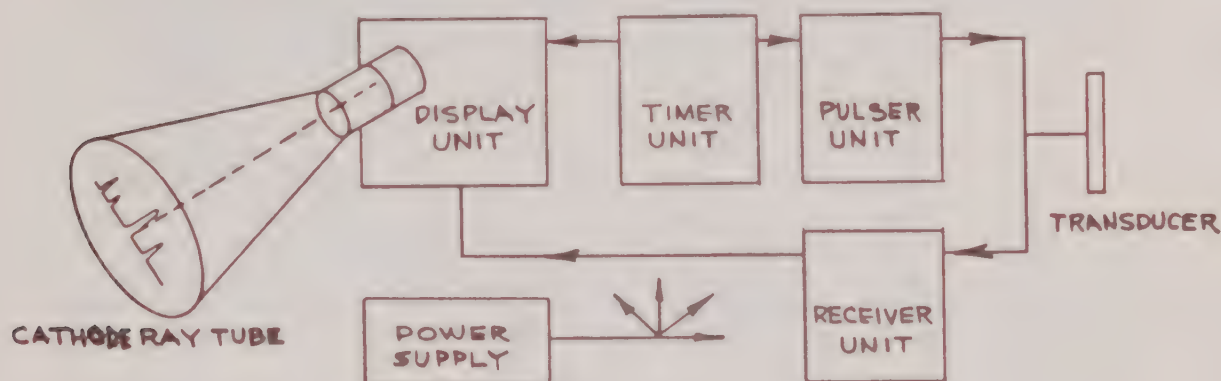


Figure B-13 Diagram of Typical Ultrasonic Flaw Detector

Naturally, the degree of inspection accuracy, clarity of display, test sensitivity and other features will greatly influence the design of any ultrasonic instrument and, in general, add to its complexity. The basic operation of such a system, however, remains unchanged and functions essentially as follows:

The pulse generator sends out electrical pulses of very short duration (usually one microsecond or less) at a rate which ranges from 100-2,000 pulses per second. Several different rates within this range can be selected by the operator. Since each pulse is of short duration, it is clear that there exists a long period of time after each pulse when no transmission occurs. During this time, the receiver is afforded an opportunity to "listen" for returning echoes or reflections from within the material under test.

The transducer, which has already emitted an ultrasonic pulse as a result of the applied electrical pulse, receives portions of this pulse as it is reflected back from discontinuities in the material. Operating in reverse, the transducer now generates electrical pulses which are then coupled to the receiver which amplifies them.

Through the use of timing circuits, all of the signals handled by the receiver, including the initial transmitted pulse, are arranged in the order of their occurrence and presented as vertical pulses or "pips" along a time base line of a cathode ray

tube. This time base line is caused by a spot moving rapidly across the picture tube and is controlled by the synchronizer to provide a time base for the analysis of the information. The motion of this spot is called the SWEEP. The earliest time is represented by the left end of the sweep and the time increases toward the right. A delay control is provided to move the sweep back and forth so that segments of time which are off the screen, either to the right or left, can be brought into view and the operator can select the segment of time which contains the echo pips which he wishes to see. The transducer may receive a large number of unwanted echoes caused by reverberations within the test sample which can be eliminated by selecting and expanding to full screen size only that time segment which contains the significant echoes.

a. Resolution

Resolution is generally interpreted as the ability of an ultrasonic test facility to clearly distinguish between closely proximate signals. Resolving power is often of particular importance in the "near field", the area of material just beneath the entry surface. Resolving power will vary from one material to another, from one type of surface to another and from one material geometry to another. Resolving power will also vary with operating frequency, type of transducer, type of instrument and proficiency of the operator. Under ideal conditions, the resolution which can be achieved using the most popular application technique associated with ultrasonic testing is $1/8$ inch in aluminum. When conditions are not ideal, $1/4$ inch or even $1/2$ inch is not uncommon. Fortunately, special techniques have been worked out which for many cases effectively cancel the resolution restriction normally related to a particular test.

b. Sensitivity

Ultrasonics is capable of penetrating metals to a depth of one hundred feet or more, although such power is seldom available in commercial equipment. The reason for this is rather elementary and serves to illustrate an important consideration regarding sensitivity. Very high instrument sensitivity can only be achieved by sacrificing instrument resolving power. Since most testing problems involve samples less than several feet thick, specific attention is given to optimizing maximum useful sensitivity with highest resolving power.

In testing metals, metallurgical differences such as grain size, alloying constituents, heat treatment and mechanical working contribute greatly to the total number of reflections which will be observed in a material. When the level of sensitivity is very high, many reflections can be received which do not in themselves indicate the

existence of a rejectable condition. Most often, the user will find that the proper operating sensitivity necessary to perform a particular test is much lower than the equipment's total capability. The actual level used is frequently determined through the use of reference standards such as the ASTM test blocks discussed in the following paragraphs.

c. Reference Standards

In ultrasonic testing, testing a standard reference is usually desirable to establish a specified test sensitivity. Ideally, standards should be constructed from the same material as that being tested and calibrated to allow for variations in metal distance and flaw size. Since the airframe industry was among the first to use ultrasonic testing, it is not surprising that an ASTM specification has been developed to cover the fabricating and checking of aluminum alloy ultrasonic standard reference blocks (ASTM Designation E 127-61T). In general, the techniques used in this specification are applicable to other metals as well; hence, a copy of this specification should be obtained if the user intends to fabricate his own standards. Copies can be procured by writing directly to the American Society for Testing Material, 1916 Race Street, Philadelphia 3, Pennsylvania (\$.50 ea.).

Test blocks are usually constructed by drilling a hole approximately $3/4$ inch deep opposite the entry surface. The diameter of the hole is $1/64$ inch or multiples of $1/64$ inch (i.e., $3/64$, $5/64$, etc.). The hole size is commonly called by the multiplier for example, a $3/64$ inch diameter hole would be referred to as a number three ($3/64$) hole. After the hole is inserted in the block, the hole bottom is made first through the use of a flat faced drill. The hole entrance is then sealed with a suitable plug to limit surface corrosion.

The distance the flat bottom hole will be from the entry surface will be dictated by the size of the part to be tested. Usually, it is desirable to have blocks of various distances to insure that complete inspection of the part is being accomplished. The accepted designation for this distance between the flaw and the entry surface is taken as the block size, hence, the physical size of a test block is always greater by three quarters of an inch than the stated block size. Tables B-1 & B-2 illustrate the blocks recommended in the basic ASTM sets.

TABLES B-1 AND B-2

Dimensions and Identification of Reference Blocks in the Basic ASTM Set.

TABLE B-1

Hole Diameter	Metal Distance	Overall Length	Block Ident.
3/64	3.000	3.750	3 - 0300
5/64	0.125	0.875	5 - 0012
5/64	0.250	1.000	5 - 0025
5/64	0.500	1.250	5 - 0050
5/64	0.750	1.500	5 - 0075
5/64	1.500	2.250	5 - 0150
5/64	3.000	3.750	5 - 0300
5/64	6.000	6.750	5 - 0600
8/64	3.000	3.750	8 - 0300
8/64	6.000	6.750	8 - 0600

TABLE B-2

Hole Diameter	Metal Distance	Overall Length	Block Ident.
1/64	3.000	3.750	1 - 0300
2/64	3.000	3.750	2 - 0300
3/64	3.000	3.750	3 - 0300
4/64	3.000	3.750	4 - 0300
5/64	3.000	3.750	5 - 0300
6/64	3.000	3.750	6 - 0300
7/64	3.000	3.750	7 - 0300
8/64	3.000	3.750	8 - 0300

d. Choice of Test Frequency

From the discussion of resolution and sensitivity (see pages it will be seen that two basic principles should be considered when choosing the frequency at which a particular test should be conducted.

1. The highest frequency will provide the greatest sensitivity for detection of small defects as well as detection of all forms of metallurgical discontinuities.
2. The lowest frequency will provide the greatest depth of penetration.

In general, higher frequencies provide more detailed information permitting echoes to be received from closer to the surface, smaller reflecting surfaces, and boundaries between media which are not greatly different in ultrasonic properties. Lower frequencies provide greater penetrating power through highly attenuative media such as bond structure. Usually, a frequency is selected which gives the best compromise between the above, the highest frequency which gives adequate penetration being selected.

Table B-3 gives a very general guide to common frequencies employed for various inspection applications.

TABLE B-3

APPLICATION FREQUENCIES

Frequency Range	Test Application
1 MHz	Castings: Course Grained Materials, Gray Iron, Nodular Iron, Copper and Stainless Steel.
1 MHz to 2.25 MHz	Castings: Fine Grained Materials, Steel, Aluminum, Brass, Etc. Plastics, Propellants, and Powder Grains Welds (Ferrous and Nonferrous)
2.25 to 5 MHz	Drawn and Extruded Products: Bars, Tubes and Shapes (Ferrous and Non-Ferrous) Forgings (Ferrous and Non-Ferrous) Glass and Ceramics Rolled Products: Metallic Sheet, Plate, Bars and Billets
5 MHz and Above	Small Forgings and Worked Materials with Refined Grain Size

c. Surface Condition Requirements

Efficient inspection requires a suitable test surface on the material being inspected. The following general rules should be used as a guide for surface conditioning prior to testing.

1. Machined surfaces under 125 microinch roughness are usually satisfactory for most testing. For detection of defects 1/64 or smaller, a finish under 63 microinches is normally required.
2. Rolled or forged surfaces are usually satisfactory if loose dirt and scale are removed. In some cases, special cleaning and smoothing with a sander or power brush may prove necessary. Scale itself, if reasonable smooth and securely bonded to the metal, need not be removed for testing.

3. Irregular surfaces obviously are the most difficult to test. Usually, a disc sander can be used to smooth out a flat test surface large enough to accomodate the transducer. In such cases, it may be necessary to make spot checks rather than conduct 100% inspection.

B2.0 Basic Testing Methods

B2.1 Testing Standards and Specifications

SOCIETY FOR NONDESTRUCTIVE TESTING, INC.
914 Chicago Avenue, Evanston, Illinois

SNT Airframe Committee

Recommended Ultrasonic Acceptance
Standards for Airframe Aluminum Alloy
Plate, Forgings and Extrusions.

Reference Texts

Nondestructive Testing Handbook in Two
Volumes

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street, Philadelphia, Pennsylvania

<u>ASTM No.</u>	<u>TITLE</u>
A435-59T	Ultrasonic Testing and Inspection of Steel Plates of Firebox and Higher Quality
A418-57T	Ultrasonic Testing and Inspection of Turbine and Generator Steel Rotor Forgings
E164-60T	Ultrasonic Contact Inspection of Weldments
E114-55T	Recommended Practice for Ultrasonic Testing by the Reflection Method, Using Pulsed Longitudinal Waves Induced by Direct Contact.

A388-59 Ultrasonic Testing and Inspection of
Heavy Steel Forgings.

B2.2 Conventional Inspection

Most ultrasonic testing can be performed by using a single straight-beam transducer. This method of testing is usually considered to be the conventional approach. By using this method, a flaw can be detected in one of two ways. A pip can appear on the trace of the cathode ray tube which will indicate the presence of a flaw directly, or the back surface pip appearing on the trace of the CRT may drop in amplitude, indirectly indicating the presence of a flaw. The latter technique has proven to be of considerable value when the orientation of internal flaws are of a random nature. It should be kept in mind that flaws which do not occur at right angles to the oncoming beam will deflect the wave in such a manner that little or no reflection is obtained from the flaw itself.

Figure B-14 illustrates what occurs as an ultrasonic wave passes through a sample. In actual practice, some of the energy reflected from a flaw or back surface will be reflected back into the part a second time when it strikes the entry surface. As a matter of fact, this process of reflecting back and forth will be repeated many times until all of the wave energy is absorbed by the material and dissipated as heat. The presence of reflection multiples can be confusing to a new operator; however, once the relevant signals are identified, the equipment can be adjusted to obscure these unwanted multiples.

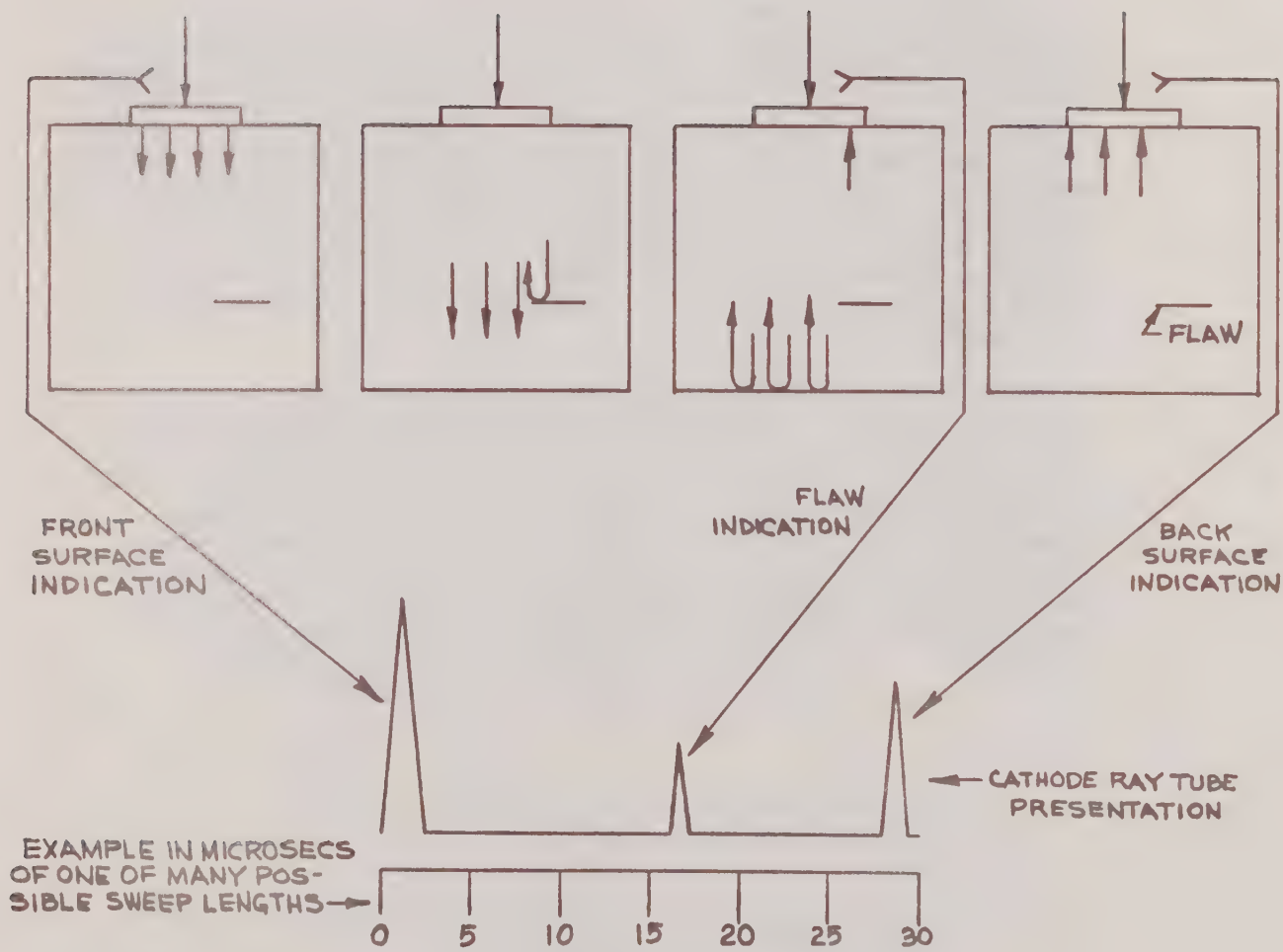


Figure B-14 Conventional Inspection Method

Normally, the operator will have little difficulty in identifying flaws with respect to size and location. Occasionally, multiple reflections from a defect close to the entry surface will occur before the first reflection from the back surface is received. As illustrated in Figure B15 each succeeding reflection is lower in amplitude and equally spaced along the time base. Retesting the material from the reverse side is recommended in order to determine if a single flaw with multiples is present or if the material contains several flaws.

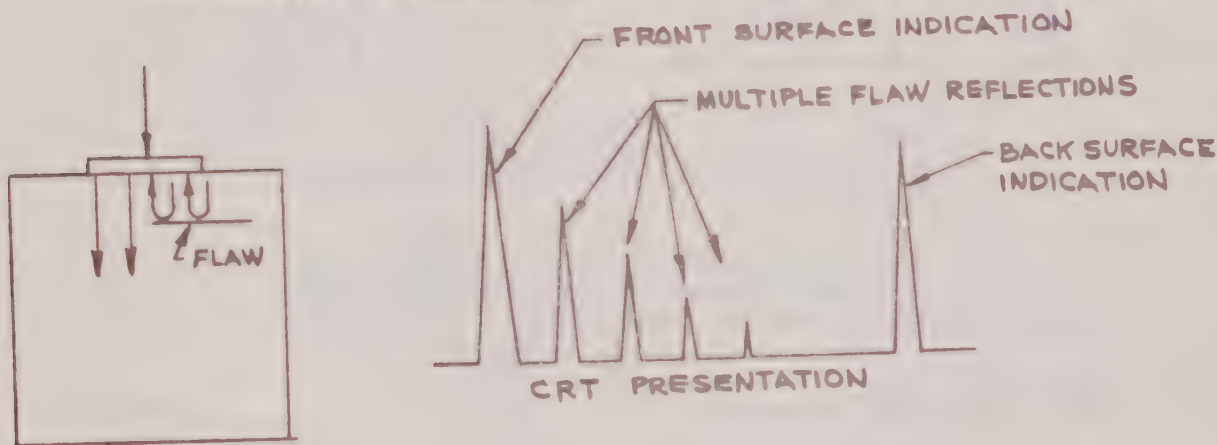


Figure B-15 Multiple Back Reflections

B2.2.1 Multiple Reflection Inspection

A variation of the conventional method of inspection is the multiple reflection technique. Figure B16 illustrates the CRT presentation used. As ultrasonic energy propagates between the front and back surfaces of a material, the height of each succeeding pulse is dependent on the preceding one; hence, the number of multiples, or more correctly, the lack of a certain number of multiples, is an indication of ultrasonic attenuation. Changes in attenuation may be caused by flaws, internal stresses, incorrect heat treatment, differences in the physical or chemical structure of a material, etc. This method has been found very effective when sufficient information concerning the material to be tested is available.



Figure B-16 Various Back Reflections

- (a) Typical back reflections from sound material,
- (b) Back reflections from porous material - gain setting same as shown in (a).

B2.2.2 Angle-Beam Inspection

Angle beam inspection is similar to straight beam or compression wave inspection except the transducer is designed to transmit ultrasonic pulses into the work piece at an angle. To avoid creation of several dominant waves in the material at the same time, angle-beam transducers are designed to produce only shear waves. From an application standpoint, shear waves may be treated the same as longitudinal waves so long as it is remembered that the speed or velocity of the wave is only approximately one half that of the more conventional longitudinal wave. Figure B-17 illustrates how this wave is transmitted.

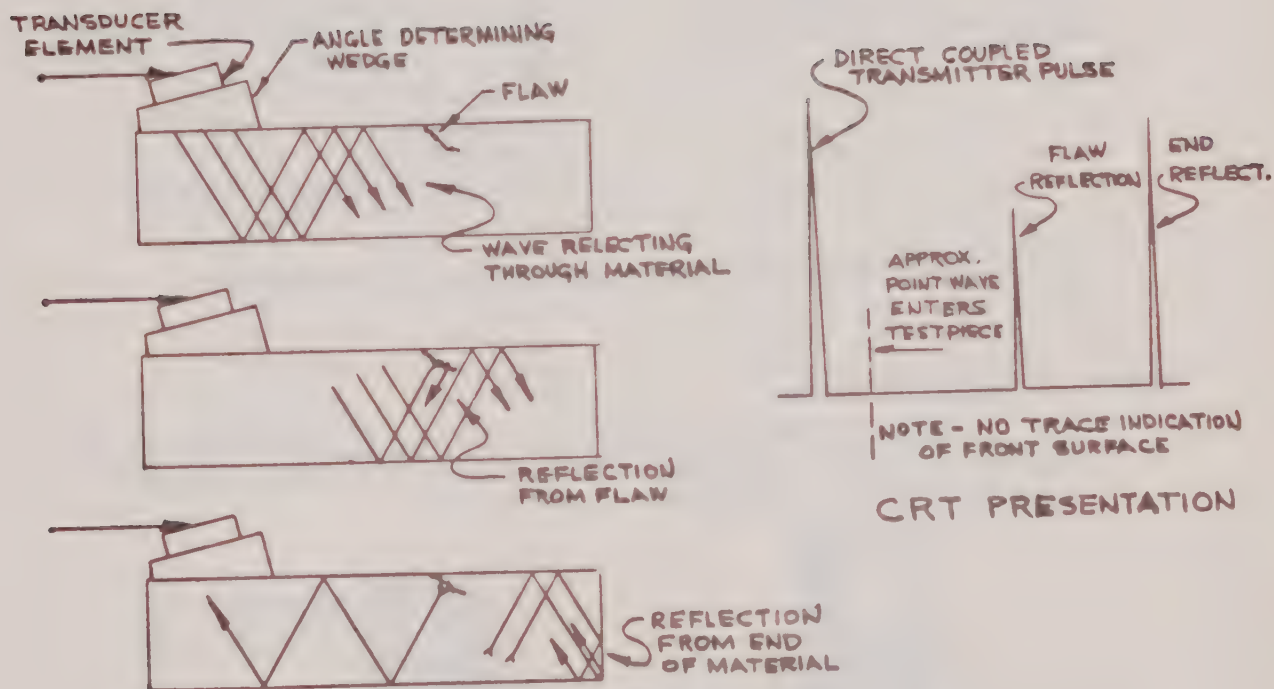
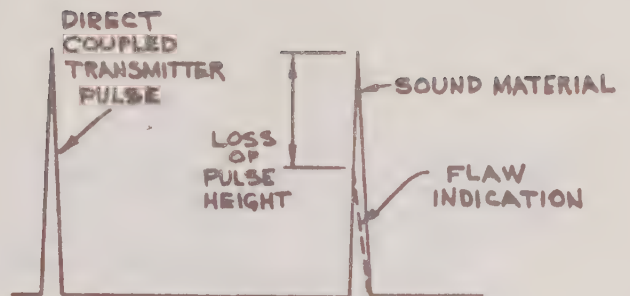


Figure B-17 Angle Beam Inspection Method

B2.2.3 Through Transmission Inspection

In addition to the inspection methods involving one transducer for sending and receiving, a two-transducer system is sometimes used. The most important advantage to this technique is that it provides great resolving power. As illustrated in Figure B18, energy is transmitted directly through the part and received by a second transducer on the opposite side. Although no direct flaw indication is observed using this technique, loss of amplitude of the received signal indicates the presence of a flaw. Through-transmission inspection is often used in the inspection of highly attenuative materials.



CRT PRESENTATION

Figure B-18 Through Transmission Method of Inspection

B2.2.4 Immersion Testing

Ultrasonic testing is many times best accomplished through the use of immersion techniques. In the following section, a variety of immersion testing situations are presented.

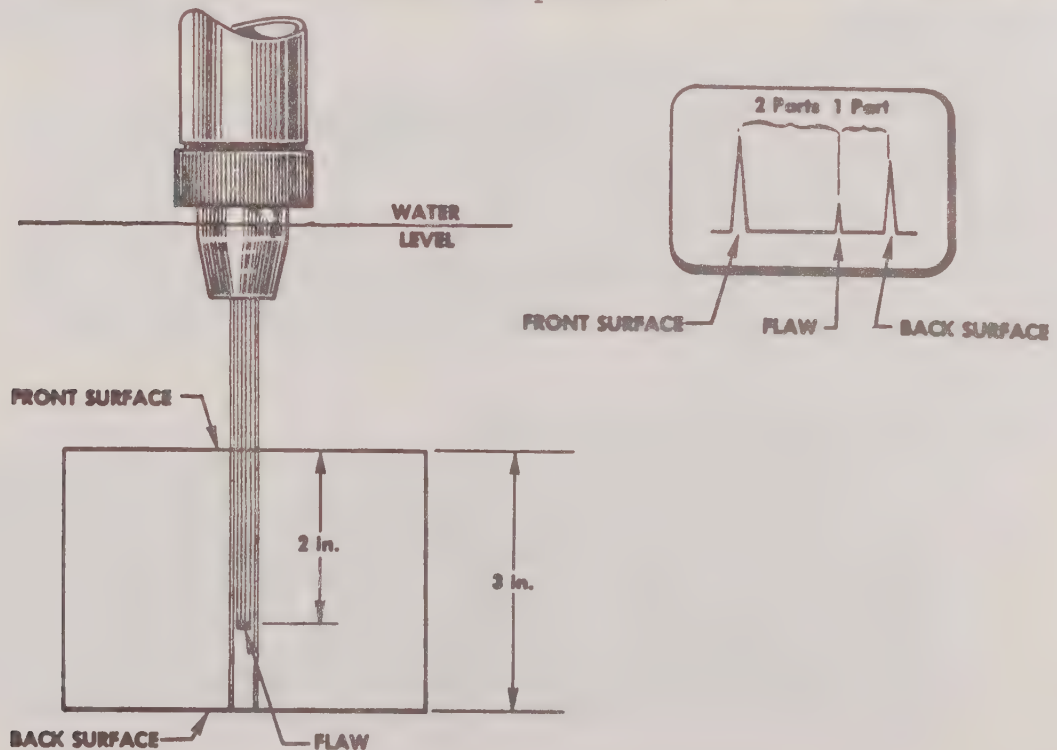


Figure B-19 Type 1, Display Interpretation

B2.2.4.1

Type 1: (See Figure B19) The sample, in this case, would be a smooth surfaced rectangular or cylindrical block with parallel surfaces which can be placed directly under the search tube and at right angles to it. In such a case, clear pips representing the front and back surfaces of the material will be seen, and any flaw pips which are present will appear between these two. The DELAY control and the IN/DIV switch can be adjusted so that the pips representing the front and back surfaces are spaced as widely as possible on the scope to give maximum accuracy in reading the depth at which any flaws are located. The horizontal scale markers assist in determining the location of flaws. The echo from the front surface of the metal returns first and is located at the left-hand side of the screen. The echo from the back surface of the sample arrives last and is located at the extreme right of the screen. A pip which is located two-thirds of the distance from the front echo indicates a flaw which is two-thirds of the thickness of the sample below the upper surface. If the flaw is sufficiently large, all of the remaining sound may be reflected from it. In this case, the back surface echo will disappear because the flaw is casting an ultrasonic shadow on the back surface.

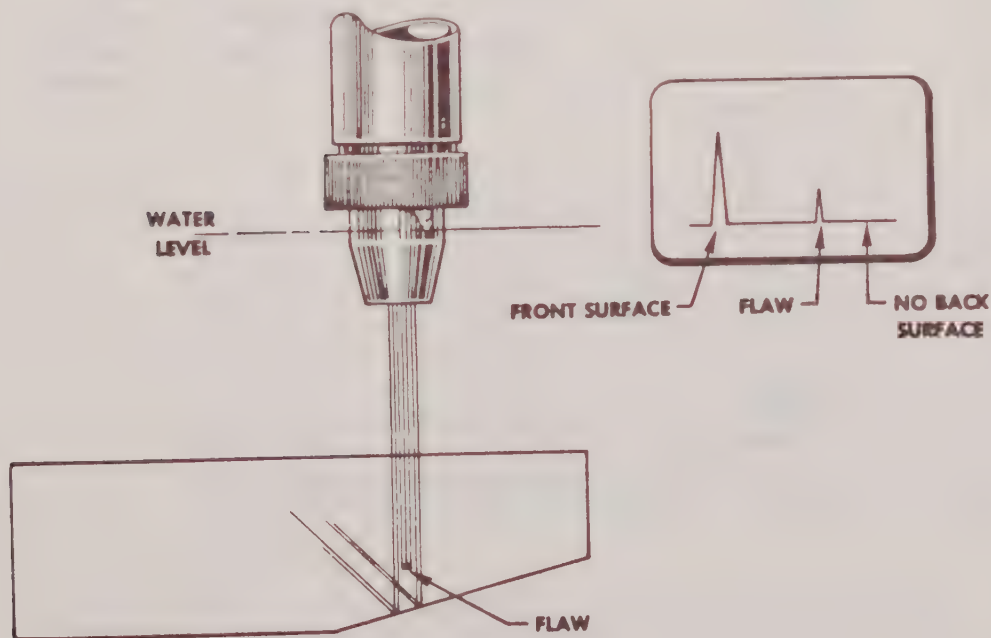


Figure B-20 Type 2, Display Interpretation

B2.2.4.2

Type 2: (See Figure B20) Type 2 situations those in which the back surface of the sample to be tested is not parallel to the front surface. When the sound waves reach the back surface, they will be reflected at an angle and will not return to the transducer. The pattern on the screen will not have a right hand pip which represents an echo from the back surface. If a second pip does appear, it probably represents a flaw. If there is any question as to whether this second pip is a flaw or an echo from the back surface, check the setting of the IN/DIV switch. If a pip appears on the horizontal scale of the CRT at a point which represents less than the total thickness of the test piece, the pip is a flaw indication.

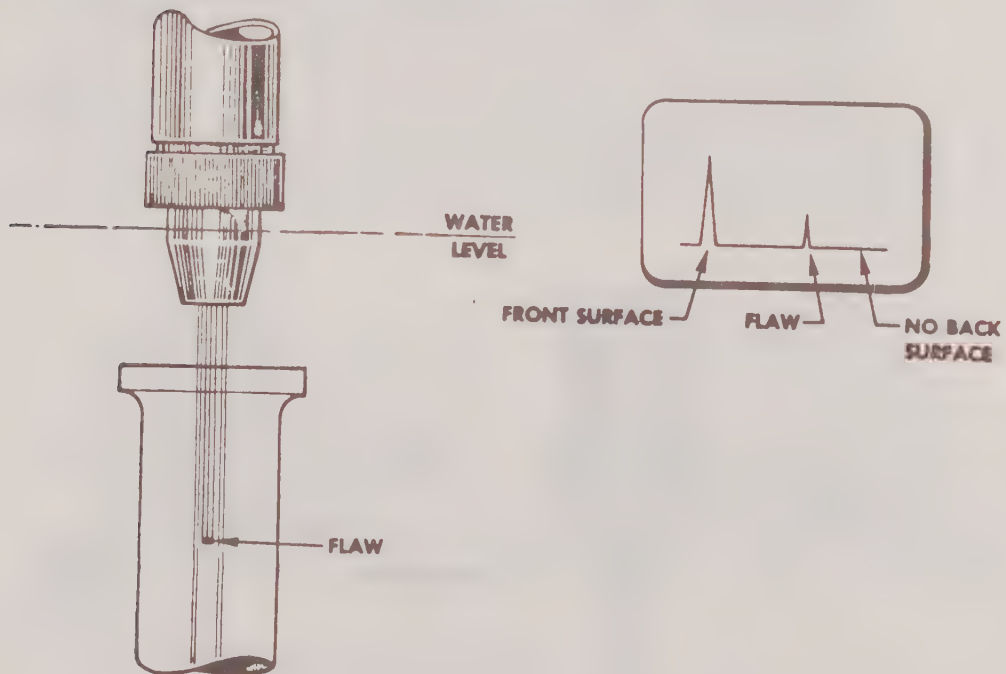


Figure B-21 Type 3, Display Interpretation

B2.2.4.3

Type 3: (See Figure B21) The sketch shown for Type 3 indicates a situation in which the depth of the material through which the sound waves have to pass is so great that the energy is attenuated before it can return. Any pip to the right of the one representing the front surface will be from a flaw or geometric boundary. The IN/DIV switch and horizontal scale of the CRT will

indicate the distance below the testing surface of any received signal.

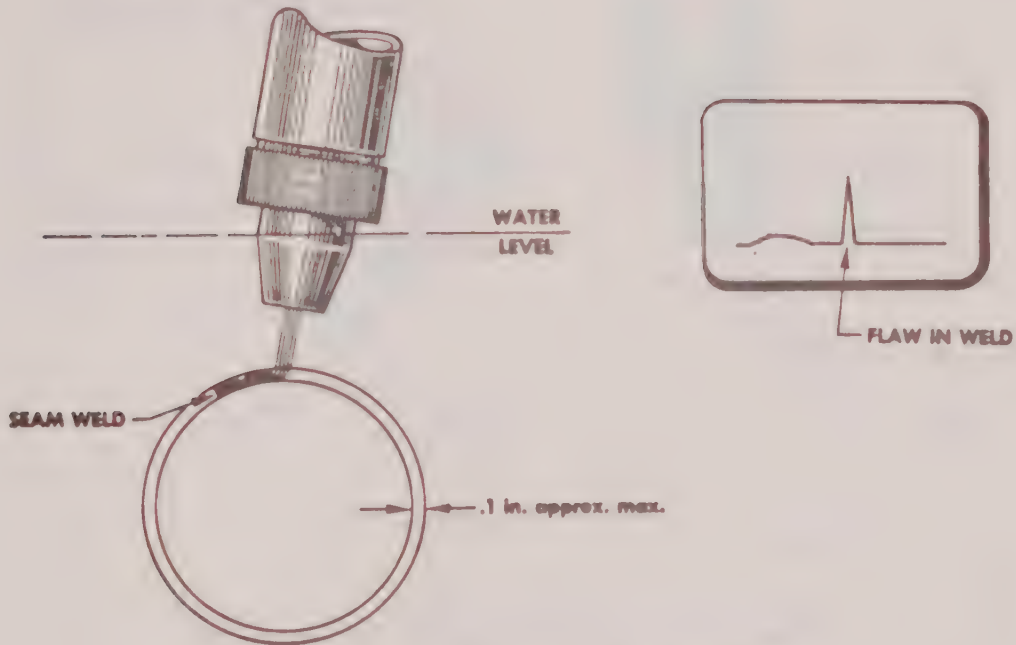


Figure B-22 Type 4, Display Interpretation

B2.2.4.4

Type 4: (See Figure B22) In Type 4, the subject being tested is a seam weld on a piece of thin walled tubing. The behavior characteristics of ultrasound at an acute angle of approach are such that some of the sound energy will be reflected from the surface and be lost. The rest of the energy will become trapped in the circular path of the metal and very little echo will be received from either the front surface or the back surface. Those waves which are proceeding through the wall of the tubing will strike any obstruction in the wall at approximately right angles, and will return an echo from such an obstruction. These conditions will prevail in a tube with walls up to 1/10 of an inch in thickness.

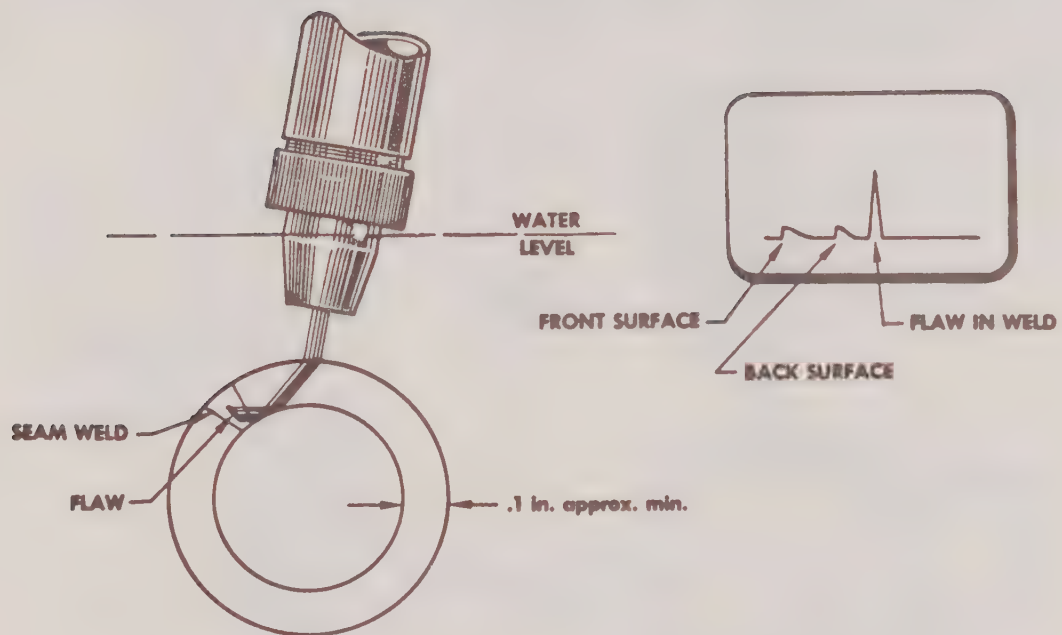


Figure B-23 Type 5, Display Interpretation

B2.2.4.5 Type 5: (See Figure B23) When inspecting a welded tube with a wall thickness in excess of 0.125 inches, you will find refraction conditions are such that pipes may be obtained representing both the outer and inner surfaces of the pipe together with pips from any flaws which may be in the pipe. The differences between the results received under Type 4 and Type 5 are due entirely to the increased thickness of the material of the tube walls in Type 5.

SHEAR WAVE INSPECTION

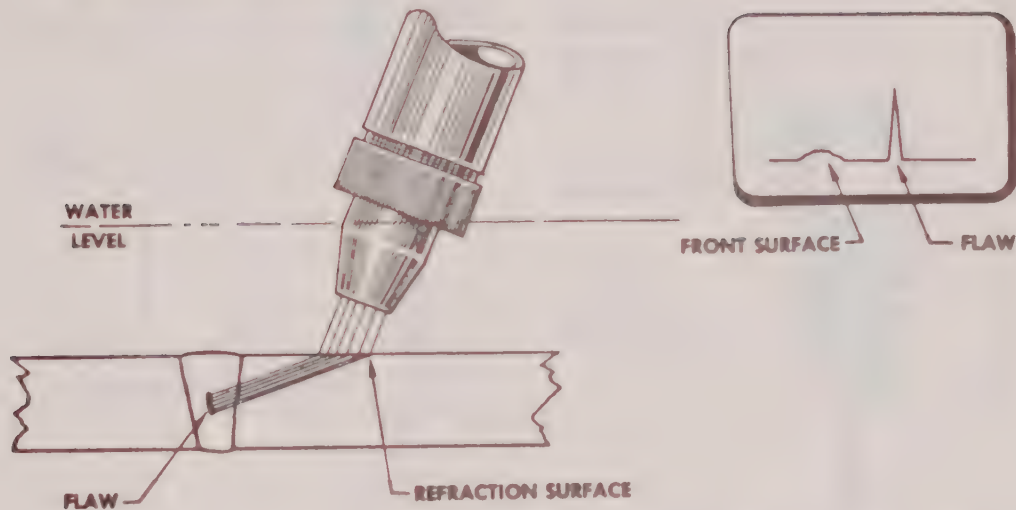


Figure B-24 Type 6, Display Interpretation

B2.2.4.6 Type 1: (See Figure B24) The illustration presented for Type 1 represents the inspection of a weld in a heavy plate. It is necessary to cause the beam to enter from some angle such as 70° from the surface. The ultrasound when it leaves the water and enters the metal will refract such that the beam will be travelling nearly parallel to the metal surface inside the metal.

When the ultrasonic beam enters the metal at some angle other than normal (90°) to the surface, the internal angle will change rapidly for small changes in the external angle. This is due to the fact that the velocity of ultrasound in water is approximately one-fourth of that in steel. For small deviations from normal, such as less than 10° , the angle of refraction will be approximately four times the angle of incidence. If the angle of incidence exceeds approximately 15° , the sound waves will be converted from longitudinal to shear waves which travel at approximately half the velocity of the longitudinal waves. To produce shear waves, tilt the search tube to some angle away from normal that lies between 0° and 33° .

In shear wave inspection, a rather small and poorly defined echo is obtained from the front surface of the material. A strong echo

will be returned from vertical fissures or cracks in the material being inspected. If the search tube is moved horizontally toward or away from the flaw without changing angle, the flaw pip will move toward or away from the front surface pip. This is due to the fact that the acoustic path between the front surface and the flaw is made shorter or longer by the motion of the search tube.

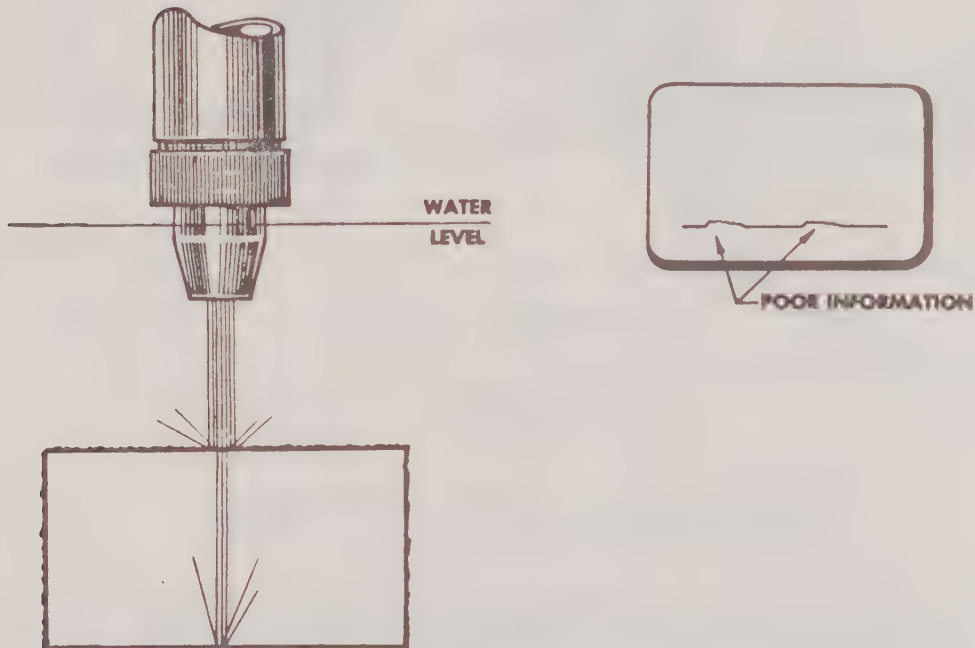


Figure B-25. Type 7, Display Interpretation

B2.2.4.7 Type 7: (See Figure B25) Type 7 represents a situation in which the front surface of the metal is so rough that a complete scattering of the sound waves is obtained. In such a situation, there will be no appreciable penetration into the metal and any possible echoes will also be dissipated by the roughness so that no echoes at all will be received. The solution to such a problem is either to have the surface smoothed sufficiently to allow normal reflection and penetration, or to penetrate the test material through a smoother surface from some other angle. It is also suggested that the lowest frequency transducer available be tried.

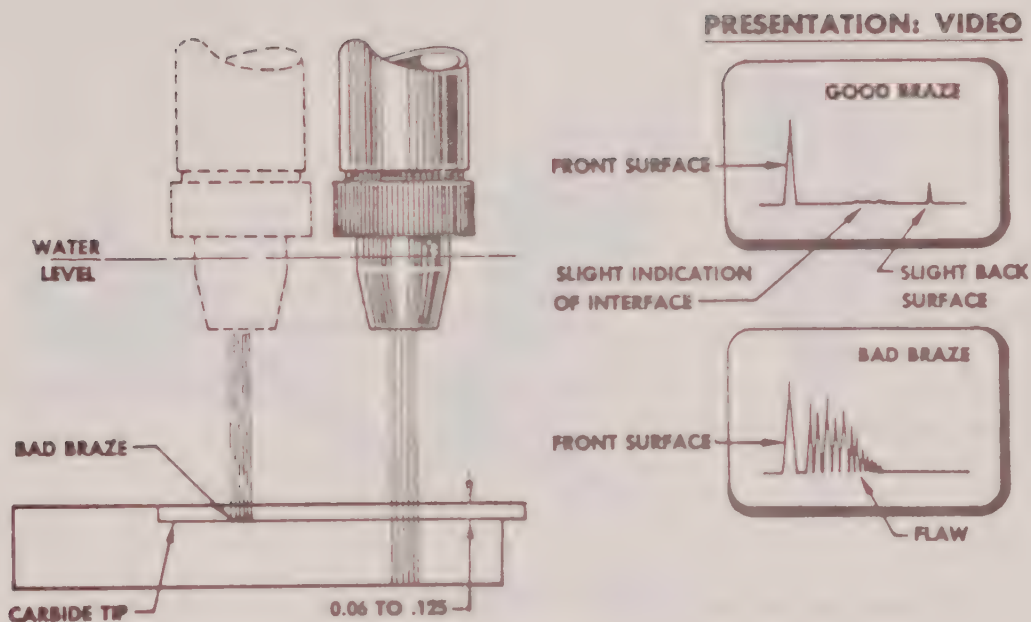


Figure B-26 Type 8, Display Interpretation

B2.2.4.8

Type 8: (See Figure B26) Type 8 represents a situation in which two different materials have been brazed or bonded face to face. Where a good uniform bonding has been obtained, normal front and back pips and a series of very small ridges which represent the two surfaces, the sound waves will be unable to penetrate the void and the pip from the bottom plate will be lost entirely. At the point on the sweep which represents the location of the bonding surfaces, a series of pips like tall grass will appear which represent reverberations of the sound waves within the top plate.

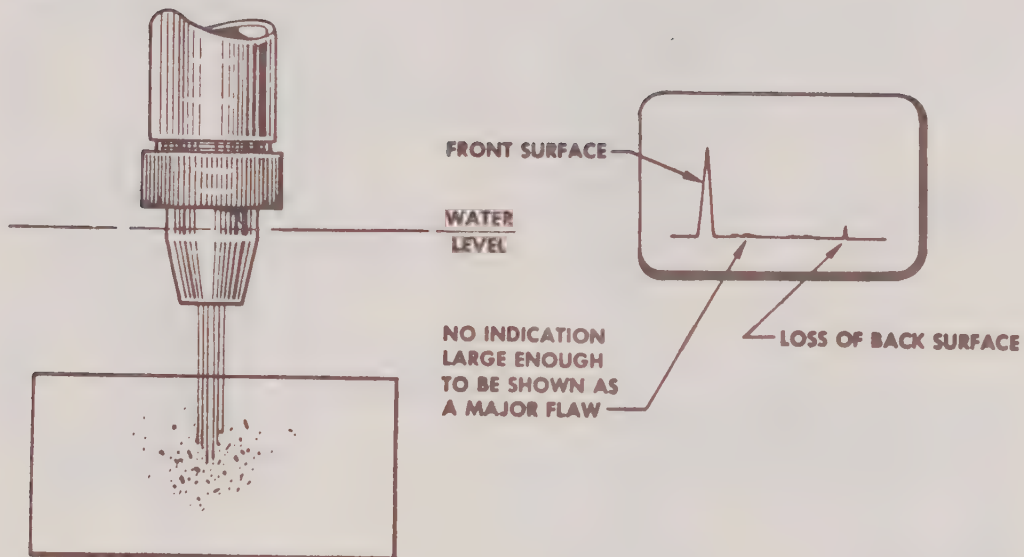


Figure B-27 Type 9, Display Interpretation

B2.2.4.9

Type 9: (See Figure B27) Type 9 represents a situation in which inspection is attempted on relatively porous material. The front pip will be clear, but the back pip will be small or even non-existent, because the ultrasonic waves have either been absorbed or dissipated by the porous nature of the material. The clear pip of the front surface will probably be followed by a long series of bumps or very short "grass", which represent tiny echoes received from the porous structure itself and do not actually represent flaws. If a significant flaw is located within the material, it should create a pip of sufficient size to be recognized. Ultrasound will not penetrate deeply into exceptionally porous materials, especially at the higher frequencies.

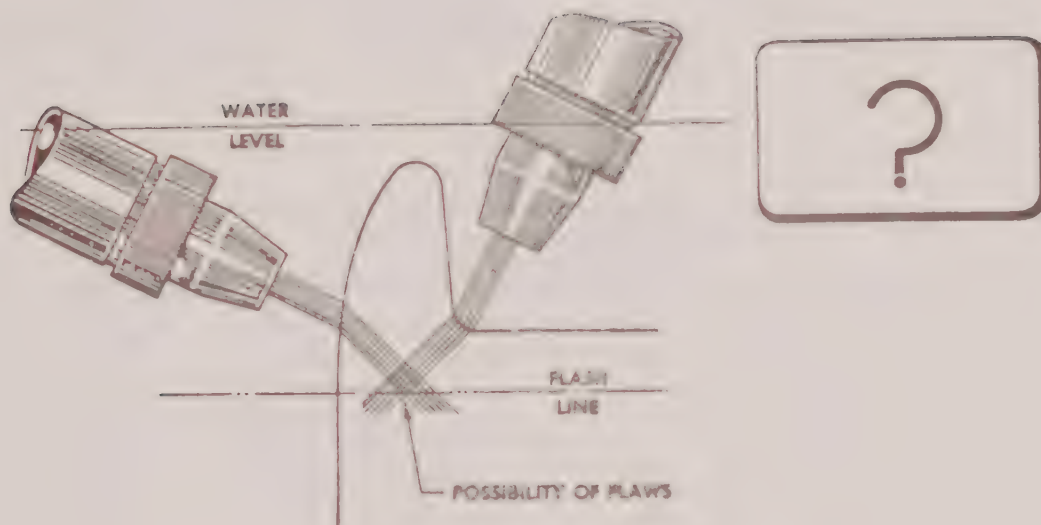


Figure B-28 Type 10, Display Interpretation

B2.2.4.10

Type 10: (See Figure B28) If any or necessary to inspect a sample which involves complex curved surfaces which do not fit any of the types illustrated above. In such cases, it is recommended that Automation Industries, Inc., Sperry Division, be consulted concerning special techniques.

APPENDIX C

PARTS LIST

C1.0 INTRODUCTION

C1.1 This section contains information for ordering and replacing parts for the UM-771/775 Reflectoscope CRT Display.

C1.2 Table C-1 is a list of Reference Designators and Abbreviations which is used in the Text and Parts List.

TABLE C-1

UM-771/775 REFLECTOSCOPE TEXT ABBREVIATIONS	
A.C. = Alternating Current	M = Milli = 10^{-3}
AMPL = Amplifier	Meg = 10^{-6}
C = Capacitance	MHz = 1 million cycles per second
CCW = Counter Clockwise	N = Nano = 10^{-9}
CRT = Cathode Ray Tube	PF = Picofarads = 10^{-12}
CW = Clockwise	R = Resistor
D.C. = Direct Current	RF = Radio Frequency
F = Farad	SPDT = Single Pole Double Throw
GND = Ground	STL = Steel
Hz = Cycles per second	U = Micro = 10^{-6}
K = Kilo = 10^{-3}	
KHz = 1000 cycles per second	

(Continued)

TABLE C-1 (Cont'd)

UM-771/775 REFLECTOSCOPE REFERENCE DESIGNATORS

ASS'Y = Assembly
 ASTIG = Astigmatism
 ATTEN = Attenuator
 AUTO = Automatic
 AUX = Auxiliary

 CT = Center Tap

 DAC = Distance Amplitude
 Correction
 D.S. = Delay Sync
 DEFL = Deflection
 DIFF = Differentiated

 F = Fuse
 FET = Field Effect Transistor
 FILT = Filter
 FREQ = Frequency

 GA = Gated Attenuator

 HORIZ = Horizontal

 IN/DIV = Inches per Division
 IF SYNC = Interface
 Synchronization
 INT = Intensity

 J = Jack

 K = Relay
 KV = Kilovolts

L = Inductor

 P = Plug
 P.C. = Printed Circuit
 PPS = Pulse per Second
 P/R = Pulser Receiver
 PRF = Pulse Repetition Rate

 Q = Transistor

 R = Resistor

 S = Switch
 SENS = Sensitivity
 SYNC = Synchronization

 T = Transformer
 T/R = Transmit Receive
 TRF = Transmit Receive Frequency

 $\mu\text{s}/\text{IN}$ = Microseconds per inch

 V = Vacuum Tube
 VAC = Volts Alternating Current
 VER = Vertical
 V.S. = Video Sync

 W = Cable

 X = Socket

 Y = Crystal

APPENDIX C

PARTS LIST

C1.0 INTRODUCTION

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(Continued)

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 V = Vacuum Tube
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 W = Cable

 X = Socket

 Y = Crystal

C1.3 The majority of all electrical components capacitors, resistors, etc. are clearly printed on the four P.C. Board Assemblies. For parts identification, parts break-down list will be included. Components other than four P.C. Board Assemblies will be identified by parts drawings and by parts breakdown lists.

C2.0 ORDERING INFORMATION

C2.1 In ordering a replaced part from Sperry Division address the parts order list or inquiry to the Automation Industries, Inc., Sperry Division, Danbury, Conn., U.S.A. and supply the following information:

- a. Sperry Instrument model number.
- b. Serial number.
- c. Desired quantity of parts.
- d. Schematic symbol, part number and description.

C3.0 TABLE OF BOARD NUMBERS (TABLE C-2)

C3.1 The below list of four P.C. Board Assemblies are tabulated according to assembly number, and are arranged in descending alpha-numerical order. The P.C. Board Assembly numbers appear on each page of the Parts List.

TABLE C-2

P.C. BOARD ASSEMBLIES

TABLE NO.	ITEM	PAGE NO.
C-4	Low Voltage Power Supply P.C. Bd. Ass'y 50D568	C-5
C-4	Vertical & Horizontal Deflection P.C. Bd. Ass'y 50D569	C-9
C-4	High Voltage Pwr Supply P.C. Bd. Ass'y 50D573	C-12
C-4	Interconnect Bd. Ass'y 50C1370	C-5

C4.0 PARTS LIST (TABLE C-4)

C4.1 Table C-4 contains a list of parts in alpha-numerical order and under the particular board number (See Table C-2) the following information is given:

- a. Title, board number and unit identification.
- b. Schematic control.
- c. Part number
- d. Description.

C4.2 Schematic unit symbols (resistors, capacitors and etc.) are printed on the four P.C. Board Assemblies for easier identification and location purposes.

Description of component parts given in Table C-4 are as complete as possible to help assist in procuring the part other than Sperry Division. However, many parts are manufactured only by Sperry Division and therefore are available at Sperry. Contact the Automation Industries, Inc., Sperry Division, Danbury, Conn., U.S.A., Sales/Service Office.

C5.0 For parts identification other than P.C. Board Assembly, additional parts breakdown list will be included in Tables C-5 through C-7).

C5.1 This will include parts breakdown drawing and parts list. The following information for each item is given:

- a. Item number
- b. Schematic Symbol
- c. Part number
- d. Description

C5.2 Table C-3 contains a list according to assembly number.

TABLE C-3

ASSEMBLY PARTS BREAKDOWN

TABLE NO.	TITLE	PAGE NO.
C-5	Transformer Chassis Ass'y 50C1355	C-15
C-6	High Voltage and Plug-in Bd. Ass'y 50C1372	C-16
C-7	Rear Panel and L.V. Pwr Supply Ass'y 50E615	C-18

TABLE C-4

PARTS BREAKDOWN LIST

Interconnect Board Assembly 50C1370

Schematic Symbol No.	Part Number	Description
C101	196D157X0015GB	Capacitor 150uf 15V Sprague
C102	5HK P10	Capacitor .1uf 500V Sprague
C103	Same as C102	
C104	Same as C101	
C105	TG-P10	Capacitor .1uf 100V Sprague
C106	Same as C102	
J101	26-4200-24S	Receptacle Amphenol
J103	26 4401 24S	Receptacle Amphenol

Low Voltage Power Supply P.C. Board Assembly 50D568

Schematic Symbol No.	Part Number	Description
C201	BR60-450	Capacitor 60uf 450V C.D.E.
C202	BR-2-450	Capacitor 2uf 450V C.D.E.
C203	5GA-D10	Capacitor .001uf 1KV Sprague
C204	TT350X2	Capacitor 2uf 350V Mallory
C205	39D107F250HL4	Capacitor 100uf 250V Sprague
C206	BR-4-250	Capacitor 4uf 250V C.D.E.
C207	Same as C203	
C208	TE1501	Capacitor 2uf 150V Sprague
C209	TVA1512	Capacitor 50uf 250V Sprague
C210	Same as C206	
C211	Same as C203	
C212	Same as C208	
C213	BR50-150	Capacitor 50uf 150V C.D.E.
C214	TE1409	Capacitor 20uf 100V Sprague
C215	TE1401	Capacitor 2uf 100V Sprague
C216	39D408G25JS4	Capacitor 4000uf 25V Sprague
C217	5HK-S10	Capacitor .01uf 1KV Sprague
C218	5HK-S15	Capacitor .015uf 500V Sprague
C219	196D157X0015GB	Capacitor 150uf 15V Sprague
C220	Same as C216	

TABLE C-4

Low Voltage Power Supply P.C. Board Assembly 50D568

Schematic Symbol No.	Part Number	Description
C221	Same as C217	
C222	Same as C218	
C223	Same as C219	
CR201	CER72	Diode
CR202	Same as CR201	
CR203	Same as CR201	
CR204	Same as CR201	
CR205	VR130A	Diode Sarkes Tarzian
CR206	Same as CR205	
CR207	VR110A	Diode Sarkes Tarzian
CR208	VR80A	Diode Sarkes Tarzian
CR209	1N4736A	Diode Motorola
CR210	Same as CR201	
CR211	Same as CR201	
CR212	Same as CR201	
CR213	Same as CR201	
CR214	Same as CR209	
CR215	Same as CR201	
CR216	Same as CR150A	
CR217	Same as CR201	
CR218	Same as CR201	
CR219	Same as CR201	
CR220	Same as CR201	
CR221	2N4102	S.C.R. RCA
CR222	Same as CR207	
CR223	Same as CR201	
CR224	Same as CR201	
CR225	Same as CR201	
CR226	Same as CR201	
CR227	1N4761A	Diode Motorola
CR228	3A50	Diode Solitron
CR229	Same as CR228	
CR230	Same as CR228	
CR231	Same as CR228	

TABLE C-4

Low Voltage Power Supply P.C. Board Assembly 50D568

Schematic Symbol No.	Part Number	Description
F201	361.500	Fuse 250V 1Amp Type 8AG Littlefuse
F202	361.375	Fuse 250V 3/8Amp Type 8AG Littlefuse
F203	361.125	Fuse 250V 1/8Amp Type 8AG Littlefuse
F204	Same as F203	
F205	361.002	Fuse 250V 2Amp Type 8AG Littlefuse
F206	362.025	Fuse 250V 2-1/2Amp Type 8AG Littlefuse
Q201	MJ400	Transistor Motorola
Q202	Same as Q201	
Q203	Same as Q201	
Q204	Same as Q201	
Q205	Same as Q201	
Q206	Same as Q201	
Q207	Same as Q201	
Q208	2N5190	Transistor with Lockwashers & Insulator Motorola
Q209	2N3642	Transistor Fairchild
Q210	Same as Q209	
Q214	2N3638	Transistor Fairchild
Q216	Same as Q214	
Q217	2N5193	Transistor with Lockwashers & Insulator Motorola
R201	-	Resistor 51K 1/2W Plus or Minus 5%
R202	-	Resistor 33K 1/2W Plus or Minus 5%
R203	-	Resistor 2K 1/2W Plus or Minus 5%
R204	SV-1031	Potentiometer 10K A.B.
R205	-	Resistor 56K 1W Plus or Minus 5%
R206	-	Resistor 56K 1/2W Plus or Minus 5%
R207	-	Resistor 24K 1/2W Plus or Minus 5%
R208	-	Resistor 10K 1/2W Plus or Minus 5%
R209	Same as R204	
R210	-	Resistor 62K 1/2W Plus or Minus 5%
R211	-	Same as R201
R212	-	Resistor 18K 1/2W Plus or Minus 5%
R213	-	Resistor 6.8K 1/2W Plus or Minus 5%
R214	-	Potentiometer 5K
R215	-	Resistor 27K 1/2W Plus or Minus 5%
R216	-	Resistor 8.2K 1/2W Plus or Minus 5%

TABLE C-4

Low Voltage Power Supply P.C. Board Assembly 50D568

Schematic Symbol No.	Part Number	Description
R217	-	Resistor 510 Ohms 1/2W Plus or Minus 5%
R218	-	Resistor 92K 1/2W Plus or Minus 5%
R219	-	Resistor 2.2K 1/2W Plus or Minus 5%
R220	SV-1021	Potentiometer 1K A.B.
R221	-	Resistor 3.9K 1/2W 5%
R222	Same as R217	
R223	-	Resistor 120K 1/2W Plus or Minus 5%
R224	Same as R221	
R225	Same as R220	
R226	Same as R219	
R227	-	Resistor 160K 2W Plus or Minus 5%
R228	-	Resistor 39K 2W Plus or Minus 5%
R229	-	Resistor 36K 1W Plus or Minus 5%
R230	-	Resistor 15K 1W Plus or Minus 5%
R231	Same as R208	
R232	Same as R208	
R233	-	Resistor 1K 1/2W Plus or Minus 5%
R234	-	Resistor 10 Ohms 1W Plus or Minus 5%
R235	-	Resistor 1.5 Ohms 1/2W Plus or Minus 5%
R236	-	Resistor 100 Ohms 1/2W Plus or Minus 5%
R237	-	Same as R206
R238	-	Same as R201
R239	-	Same as R216
R240	-	Same as R201
R241	-	Resistor 3K 1/2W Plus or Minus 5%
	PA1-1B	Heatsink I.E.R.C.
	2215-B	Heatsink Thermalloy
	MPT6003	Socket Transistor Ind. Elect.
S101	50B1741	Switch, Illuminated - DS101

TABLE C-4

Deflection Amp. P.C. Board Assembly 50D569

Schematic Symbol No.	Part Number	Description
C401	TG-D50	Capacitor .005uf 100V Sprague
C402	5GA-S20	Capacitor .02uf 1KV Sprague
C403	5GA-T68	Capacitor 680pf 1KV Sprague
C404	TG-S20	Capacitor .02uf 100V Sprague
C405	TE-1135	Capacitor 100uf 12V Sprague
C406	Same as C404	
C407	Same as C402	
C408	196D104x0035DB	Capacitor .1uf 35V Sprague
C409	196D106x0020FB	Capacitor 10uf 20V Sprague
C410	5GA-T10	Capacitor 100pf 1KV Sprague
C411	5GA-Q10	Capacitor 10pf 1KV Sprague
C413	Same as C405	
C414	Same as C404	
C415	TG-S50	Capacitor .05uf 100V Sprague
C416	5GA-D10	Capacitor .001uf 1KV Sprague
C417	Same as C410	
CR401	1N914	Diode
CR402	Same as CR401	
CR403	Same as CR401	
CR404	Same as CR401	
L401	9230-32	Choke 3.3mh J. W. Miller
L402	Same as L401	
Q401	2N3906	Transistor Motorola
Q402	40423	Transistor R.C.A.
Q403	Same as Q402	
Q404	Same as Q401	
Q405	2N698	Transistor Texas Instruments
Q406	2N3563	Transistor Fairchild
Q407	2N3904	Transistor Motorola
Q408	Same as Q401	
Q409	2N3118	Transistor R.C.A.
Q410	2N3119	Transistor R.C.A.
Q411	Same as Q410	
Q412	Same as Q409	
Q413	2N2102	Transistor R.C.A.
Q414	Same as Q401	
Q415	Same as Q407	

TABLE C-4

Deflection Amp. P.C. Board Assembly 50D569

Schematic Symbol No.	Part Number	Description
Q416	Same as Q401	
Q417	Same as Q401	
R401	-	Resistor 100 ohms 1/2W Plus or Minus 5%
R402	SV-2021	Potentiometer 2K Plus or Minus 10% A.B.
R403	SV-1031	Potentiometer 10K Plus or Minus 10% A.B.
R404	Same as R401	
R405	-	Resistor 5.1K 1/2W Plus or Minus 5%
R406	Same as R405	
R407	-	Resistor 2K 1/2W Plus or Minus 5%
R408	Same as R401	
R409	Same as R401	
R410	-	Resistor 82 ohms 1/2W Plus or Minus 5%
R412	Same as R407	
R413	-	Resistor 43K 1/2W Plus or Minus 5%
R414	-	Resistor 560 ohms 1/2W Plus or Minus 5%
R415	Same as R414	
R416	-	Resistor 1K 1/2W Plus or Minus 5%
R417	-	Resistor 680 ohms 1/2W Plus or Minus 5%
R418	Same as R401	
R419	-	Resistor 10 ohms 1/2W Plus or Minus 5%
R420	Same as R407	
R421	Same as R401	
R422	-	Resistor 12K 1/2W Plus or Minus 5%
R423	NS10	Resistor 640 ohms 10W Plus or Minus 3% Dale
R424	Same as R419	
R425	Same as R423	
R426	Same as R419	
R427	-	Resistor 56 ohms 1/2W Plus or Minus 5%
R428	Same as R427	
R429	Same as R419	
R430	Same as R419	
R431	Same as R427	
R432	Same as R419	
R433	Same as R422	
R434	Same as R419	
R435	Same as R419	

TABLE C-4

Deflection Amp. P.C. Board Assembly 50D569

Schematic Symbol No.	Part Number	Description
R436	-	Resistor 5.1K 1/2W Plus or Minus 5%
R437	Same as R416	
R438	-	Resistor 1.8K 1/2W Plus or Minus 5%
R439	Same as R416	
R440	Same as R401	
R441	Same as R407	
R442	Same as R436	
R443	SV-2511	Potentiometer 250 ohms Plus or Minus 10%
R444	Same as R427	
R445	Same as R427	
R446	-	Resistor 510 ohms 1/2W Plus or Minus 5%
R447	Same as R407	
R448	-	Resistor 51 ohms 1/2W Plus or Minus 5%
R449	Same as R416	
R450	SV-5021	Potentiometer 5K Plus or Minus 10%
R451	Same as R416	
R452	-	Resistor 10K 1/2W Plus or Minus 5%
R453	Same as R436	
R455	Same as R401	
R456	Same as R446	
R457	Same as R407	
R458	-	Resistor 330 ohms 1/2W Plus or Minus 5%
R459	-	Resistor 820 ohms 1/2W Plus or Minus 5%
	50B1697	Heatsink
	50B1698	Heatsink
	MPT-4003	Socket-Transistor I.E.H.C.
	MPT-6003	Socket-Transistor Ind. Elec. Hdwr. Co.
	2215B	Heatsink Thermalloy

TABLE C-4

High Voltage P.C. Board Assembly 50D573

Schematic Symbol No.	Part Number	Description
C301	30GA-S10	Capacitor .01mf 3KV Sprague
C302	60GA-T50	Capacitor 500pf 6KV Sprague
C303	Same as C302	
C304	TT350X2	Capacitor 2uf 350V Mallory
C305	T-360C686M015AS	Capacitor 68uf 15V Kemet
C306	Same as C301	
C307	Same as C301	
C308	Same as C301	
C309	DD30-102	Capacitor .001uf 3KV Centralab
C310	196D157X0004FB	Capacitor 150uf 4V Sprague
C311	196D157X0015GB	Capacitor 150uf 15V Sprague
C312	Same as C311	
C313	DD30-202	Capacitor .002uf 3KV Centralab
C314	Same as C301	
C315	Same as C301	
C316	Same as C301	
C317	Same as C301	
C318	5GA-T22	Capacitor 220pf 1KV Sprague
C319	Same as C310	
C320	SHKP10	Capacitor .1uf 500V Sprague
C321	Same as C320	
C323	Same as C301	
C324	5GAD10	Capacitor .001uf 1KV Sprague
CR301	5D50	Diode
CR302	Same as CR301	
CR303	Same as CR301	
CR304	VR10A	Diode Sarkes Tarizian
CR305	1N914	Diode I.T.T.
CR306	Same as CR305	
CR307	Same as CR301	
CR308	1N5231B	Diode
L301	70F683A1	Choke 6.8mh
Q301	2N5193	Transistor with Lockwashers & Insulator Motorola
Q302	Same as Q301	
Q303	MJ400	Transistor Motorola
Q304	Same as Q303	
Q305	2N5087	Transistor

TABLE C-4

High Voltage P.C. Board Assembly 50D573

Schematic Symbol No.	Part Number	Description
Q306 Q307	Same as Q301 2N3906	Transistor Motorola
R301	-	Resistor 10 ohms 1/4W Plus or Minus 5%
R302	Same as R301	
R303	-	Resistor 1K Plus or Minus 5%
R304	-	Resistor 100K 1/2W Plus or Minus 5%
R305	Same as R304	
R306	-	Resistor 5K 1/2W Plus or Minus 5%
R307	NS5	Resistor 3.9K 5W Plus or Minus 3% Dale
R308	-	Resistor 10K 1/4W Plus or Minus 5%
R309	-	Resistor 360 ohms 1/2W Plus or Minus 5%
R310	-	Resistor 10 ohms 1/2W Plus or Minus 5%
R311	-	Resistor 470 ohms 1/2W Plus or Minus 5%
R312	50A4359-1	Potentiometer 250K Allen Bradley
R313	-	Resistor 150K 1/2W Plus or Minus 5%
R314	-	Resistor 150 ohms 1/2W Plus or Minus 5%
R315	Same as R304	
R316	-	Resistor 910K 1/2W Plus or Minus 5%
R317	50A4358-1	Potentiometer 1M Allen-Bradley
R318	-	Resistor 2.7M 2W Plus or Minus 5%
R319	-	Resistor 470K 1/2W Plus or Minus 5%
R320	-	Resistor 8.5M 2.5W Plus or Minus 2%
R321	-	Resistor 6.2 ohms 2W Plus or Minus 5%
R322	-	Resistor 2.2M 2W Plus or Minus 5%
R323	SH1051	Potentiometer 1M Allen Bradley
R324	Same as R312	
R325	-	Resistor 1.5M 1/2W Plus or Minus 5%
R328	Same as R308	
R329	-	Resistor 16K 1/2 W Plus or Minus 5%
R330	-	Resistor 200K 1/2W Plus or Minus 5%
R331	-	Resistor 562K 1/2W Plus or Minus 1%
R332	Same as R323	
T301	50B1740	Transformer High Voltage
VR305 VR306	284RZ Same as VR305	Neon Glow Lamps, Signalite

TABLE C-4

High Voltage P.C. Board Assembly 50D573

Schematic Symbol No.	Part Number	Description
VR307 VR308	Same as VR305 GV3A-1800 MPT4003 MPT6003 50A4398 PAI-1B A018	Corotron 1800V Victoreen Trans. Socket Ind. Elect. Hdwr. Co. Trans. Socket Ind. Elect. Hdwr. Co. Heatsink Heatsink I.E.R.C. Knob Slotted J. Millen Co.

TABLE C-5

PARTS BREAKDOWN LIST

Transformer Chassis Assy 50C1355 (See figure C-1)

Schematic Symbol No.	Part Number	Description
T101	50C1300	Transformer-for the UM771 Reflectoscope
T101	50C1367	Transformer-for the UM775 Reflectoscope

(Connectors are supplied with Transformer)

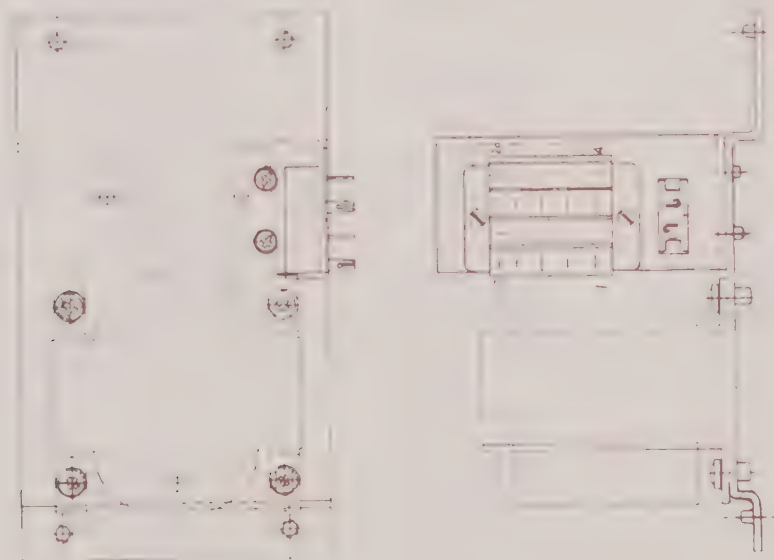


Figure C-1 Transformer Chassis (T101)

TABLE C-6

PARTS BREAKDOWN LIST

High Voltage And Plug-In Board Assembly 50C1372 (See Figure C-2)

Item No.	Schematic Symbol No.	Part Number	Description
1	P110	60-6501-3218	Connector
2	-	60-6501-0312	Contact Elco
3	-	50C1339	Plug-in P.C. Board
4	-	-	Screw #6-32x1/2 Lg. Philips Bind Hd. SST
5	-	-	Nut Hex #6-32 Small Pat. SST
6	-	-	Lockwasher #6 Int. Tooth SST
7	-	143-44-12-028	Socket Cinch Jones
8	-	242-18"	Anode Connector National Teltronic
9	-	50D573	High Voltage P.C. Board Assembly
10	-	50C1371	Harness H.V. Board to CRT & Intero. Board
14	-	42718-2	Terminal Amp
15	-	Fit-105 3/32	Black Tubing Heat Shrinkable Alpha
16	-	1920	Wire High Voltage 5KV
	V101	50B1652	CRT



TABLE C-7

PARTS BREAKDOWN LIST

Rear Panel And L.V. Power Supply Assembly 50E615
UM771/775 Reflectoscope (See Figure C-3)

Item No.	Schematic Symbol No.	Part Number	Description
1	-	50D556	Rear Panel
2	-	50C1345-1	Heat Sink
3	B101	Mark 4	Filter Fan Rotron M745 Motor
4	-	50B1727	End Cover
7	F101	3AG	Fuse 2.5A 125V Slo-Blo Littlefuse (5A 125V Used in UM771)
	F102	Same as F101	
8	-	342-12	Fuse Extractor Post 3AG Littlefuse
9	C101	DD3-103	Capacitor 2x.01uf 600V Centralab
10	J107	GE4390-1	Receptacle G.E.
11	J108	5258	Receptacle Hubbell
12	-	110	Binding Post H.H. Smith
13	Q101	MJ423	Transistor with MTG Kit Insulator Motorola
14	Q102 thru Q105	DTS410	Transistor with MTG Kit Insulator Delco
15	Q106	DTG2400	Transistor with MTG Kit Insulator Delco
16	-	00A131	Nameplate
19	-	RA2217-170M	Lug #6 T & B
22	-	-	Screw #2x3/16 Type B PHH Truss SST
23	-	-	Screw 4-40x3/8 PHH Truss SST
24	-	-	Screw 4-40x1/4 PHH Truss SST
25	-	RA2247-170M	Lug #8 T & B
26	-	-	Screw 6-32x3/8 PHH Truss SST
27	-	-	Screw 6-32x3/8 PHH Truss SST
28	-	-	Screw 8-32x5/16 PHH Truss SST
31	-	-	Hex. Nut #6-32 Small Patt. SST
32	-	50C1345-2	Heat Sink
33	-	50C1340	Rear Leg
34	-	50B1722	Fan Bracket
37	-	-	Lockwasher #4 Intl. Tooth SST
38	-	-	Screw 6-32x3/8 PHH Flat SST
39	-	-	Lockwasher #6 Intl. Tooth SST
40	-	-	Lockwasher #6 Intl. Tooth SST
42	-	50C1368	L.V. Board & Harness Assembly
45	-	3075	Wire #18 Awg STC Wht Alpha
46	-	3075	Wire #18 Awg BRN Alpha
47	-	3075	Wire #18 Awg STR BLK Alpha
48	-	3071	Wire #22 Awg BRN Alpha

APPENDIX D

SCHEMATIC

D1.0 INTRODUCTION

This section contains a fold out Schematic 50X618 for the UM771/775 Reflectoscope CRT Display. This section is supplied to supplement the information presented in the Text.

D1.1 The schematic is laid out to show the overall circuit function of the UM771/775 Reflectoscope CRT Display. The schematic provides technical information about the electrical value and identification of the capacitors, fuses, resistors, transistors, transformers, diodes, lights, and plugs. Input and output (AC-DC) voltages are shown on the schematic. These measuring points are shown as "E" numbers on the P. C. Boards. Signals such as unblanking RF etc., also are tied in to the "E" numbers on the P. C. Board. All four P. C. Boards (voltages and signals) tie in together through an Interconnection P. C. Board Assembly 50C1370. See Table D-1 for Schematic Symbols identification.

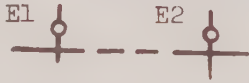
D1.2 A heavy dotted line around a particular circuit indicates a Printed Board Assembly. There are four of these heavy dotted line P.C. Board Assemblies as shown on the Schematic. Certain number series also are associated with the components on the P.C. Board Assemblies.

- a. Low Voltage Power Supply P.C. Board Assembly 50D568.
- b. High Voltage Power Supply and Unblanking P.C. Board Assembly 50D573.
- c. Deflection Amplifier P.C. Board Assembly 50D569.
- d. Interconnection P.C. Board Assembly 50C1370.

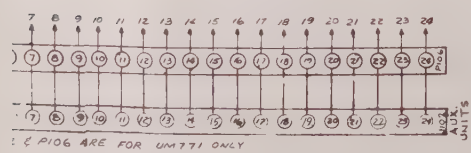
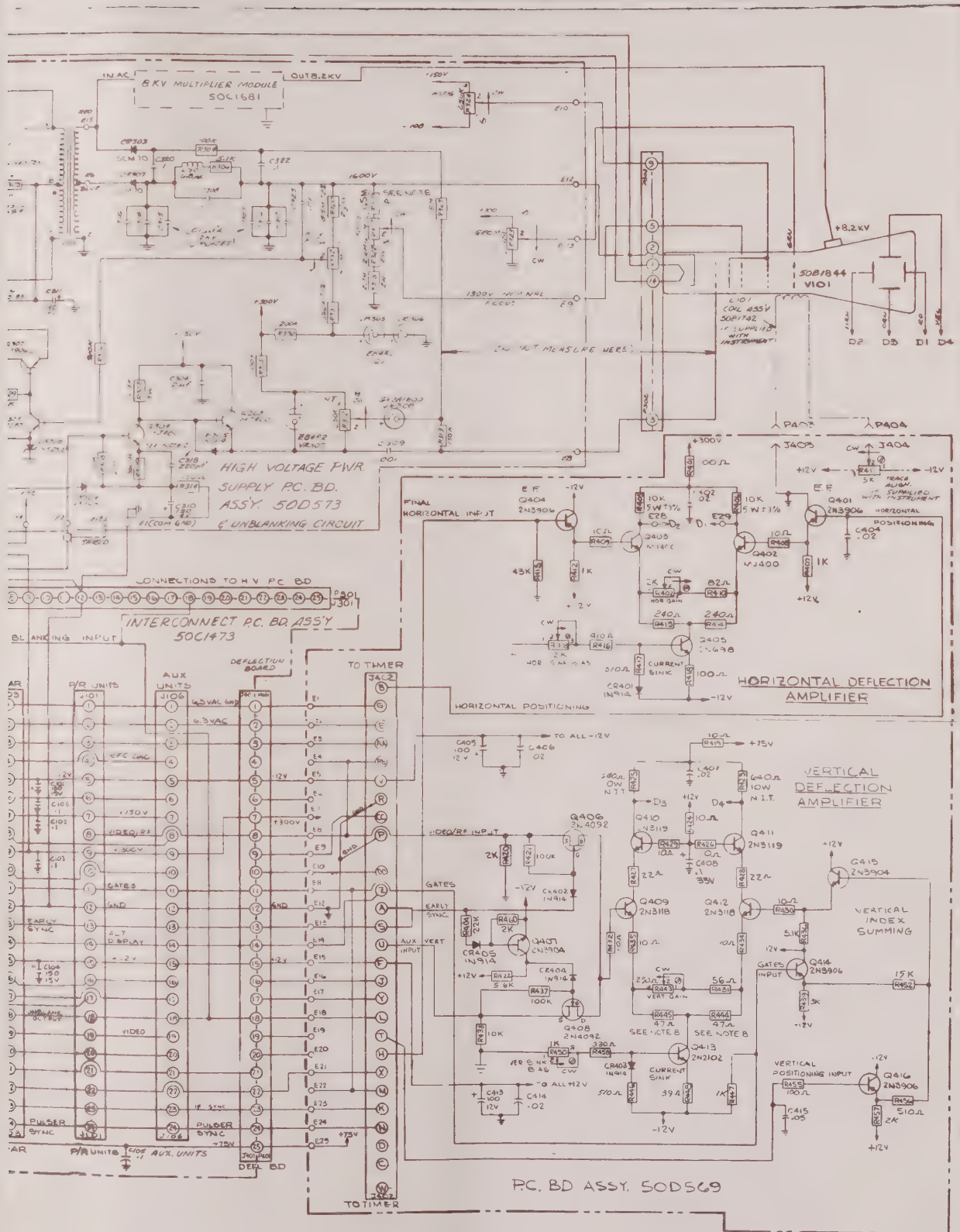
The Pulser/Receiver, Timer and Accessory Plug-in units are not shown on this schematic. Signals and voltages from these units are tied in through the Reflectoscope Display Plugs.

- a. J101 - Pulser/Receiver
- b. J402 - Timer
- c. J106 and J102 - Accessory

TABLE D-1

SCHEMATIC SYMBOLS IDENTIFICATION	
	= Screwdriver, Adjustable Resistor
	= Screwdriver, Adjustable potentiometer
	= Single Pin connector
	= Multi-pin connector
	= Gas filled Referenced Diode
	= "E" Number Connections on P.C. Bd.

PARTS LIST	
QTY	DESCRIPTION
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SECTION VI

PULSER/RECEIVER UNITS 5B, 1N, 2.25N, 5N, 10N, AND HFN

DESCRIPTION

1. GENERAL (Figure 6-1, 6-2, and 6-3)

The Pulser/Receiver units are designed as plug-in components with a quick disconnect feature for interchange or servicing. They contain the circuitry for the generation and transmission of high frequency pulses to the transducer, for receiving, amplifying, and detecting the high frequency echo or return pulses from the test specimen, and for limiting and transferring the detected video pulses to the Time Control Unit and thence to the Reflectoscope Display and any accessory equipment in use.



Figure 6-1
Pulser/Receiver Unit 5N, Typical For 1N, 2.25N And 10N

The numerical designators in the titles refer to the highest frequency (in megacycles) obtainable with a given unit. The HFN unit (figure 6-2)

is a special case in that the operating frequency is determined by the plug-in tuning board selected. Specific details of this unit's design are discussed later in this section. The 5B unit is an early type and is not covered extensively in this section; however, details of its operation are similar to the other units, and an overall schematic is included.



Figure 6-2
Pulser/Receiver Unit HFN

The early 5B unit was designed for operation with barium titanate, lead zirconate, or other ceramic transducers. The 5N and succeeding types were developed for operation with high impedance quartz or lithium sulphate transducers, as well as low impedance barium titanate, lead zirconate, and lead metaniobate transducers.

Table 6-1 contains information on operating frequencies and other characteristics which will help to clarify the differences between the Pulser/Receiver types.

TABLE 6-1
PULSER/RECEIVER TYPES

UNIT	OPERATING FREQUENCIES	COMMENTS
5B (50E523)	1.0 mc. 2.25 mc. 5.0 mc.	Designed primarily for ceramic type transducers; overall schematic in rear of section.
1N (50C529)	0.2 mc. 0.4 mc. 1.0 mc.	Different frequency range, circuitry similar to 5N.
2.25 N (50C391)	0.4 mc. 1.0 mc. 2.25 mc.	Different frequency range, circuitry similar to 5N.
5N (50C524)	1.0 mc. 2.25 mc. 5.0 mc.	Designed for all transducer types.
10N (50C519)	2.25 mc. 5.0 mc. 10.0 mc.	Different frequency range, circuitry similar to 5N.
HFN (50C390)	As selected by choice of plug-in tuning board	Design basically same as 5N, except frequency selection is by insertion of specified plug-in tuning circuit boards.

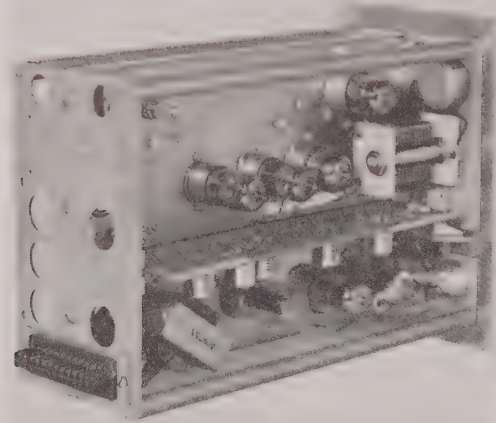


Figure 6-3
Pulser/Receiver HFN, Showing Plug-In Tuning Board Design

The Pulser/Receiver units consist of the following major components:

a. TRIGGER AMPLIFIER

Shapes and amplifies the timing signal from the Time Control Unit and furnishes a trigger pulse to the pulser circuit.

b. PULSER

Supplies a high voltage, high frequency pulse to the transducer (search unit).

c. TIME DELAY AND HIGH VOLTAGE CIRCUIT

Allows 30 second time delay for warm-up before applying high voltage to pulser thyatron.

d. RF AMPLIFIER

Receives and amplifies return (echo) high frequency pulses from transducer (search unit) and furnishes pulse to video detector.

e. FREQUENCY SELECTOR

Selects inductance values in RF Amplifier and Pulser circuits to tune unit at selected operating frequency.

f. TUNING CIRCUIT BOARD (HFN UNIT ONLY)

Plug-in circuit board containing predetermined fixed values of inductance and capacitance which tune unit at chosen operating frequency; performs function of frequency selector switch in other units.

g. VIDEO DETECTOR

Converts high frequency pulses from the RF Amplifier to video pulse signals; provides output to video gate in Time Control Unit and thence to final amplifiers in Display Unit and any accessory equipment being used.

h. LIMITER AND OUTPUT CIRCUIT

Limits maximum amplitude of video pulse (6 volts in 5B, 1N, 2.25N, 5N; adjustable in 10N and HFN) and provides low impedance coupling for output pulses.

2. MECHANICAL SPECIFICATIONS

The Pulser/Receiver units plug in to the UM Reflectoscope or Special Function cabinet and make automatic contact with other units through a plug at the rear of the chassis. The unit is easily removed for

servicing or interchange by releasing the front catch and pulling it out.

The following front panel controls are provided:

a. PULSER CONTROLS:

PULSE LENGTH

PULSE TUNING

b. GAIN CONTROLS:

COARSE SENSITIVITY (switch; except in HFN)

FINE SENSITIVITY

c. VIDEO CONTROLS:

REJECT

d. FREQUENCY CONTROLS:

FREQUENCY (switch; except in HFN)

e. TEST CONTROLS:

TEST (switch)

f. RECEPTACLES:

RECEIVER (left)

TRANSMITTER (right)

3. ELECTRICAL SPECIFICATIONS

All power requirements are obtained from the UM Reflectoscope through automatic mating of connectors when the unit is installed. The timing signal from the Time Control Unit is obtained in the same manner; as is the transfer of the video signal to the Time Control Unit.

OPERATION

1. FUNCTION OF CONTROLS (Figure 6-1 and 6-2)

a. PULSER CONTROLS

(1) PULSE LENGTH

The PULSE LENGTH control is used to adjust the time duration of the high frequency pulse applied to the transducer (search unit). It should be adjusted to maximize signal return while maintaining required resolution. (It should be left near minimum and increased only to gain signal strength if maximum sensitivity does not suffice; excessive pulse length can obscure signals from defects close to the test surface.)

(2) PULSE TUNING

The PULSE TUNING control is a capacitive adjustment which compensates for slight variations in distributed capacitance and other characteristics between cables and transducers. Depending on the requirements of the test situation, it should be adjusted to produce either the largest or most distinct indications.

b. GAIN CONTROLS

(1) COARSE SENSITIVITY (switch)

The COARSE SENSITIVITY switch adjusts the gain of the RF Amplifier in three ranges: X.1, X1, and X10.

(2) FINE SENSITIVITY

The FINE SENSITIVITY control provides a continuous adjustment of RF Amplifier gain within the ranges noted above.

c. VIDEO CONTROL

(1) REJECT

The REJECT control in the video detector is used to block passage of low level irrelevant signals and noise signals for a clean CRT presentation which permits easier interpretation of echo signals. See Familiarization Section regarding cautions to be observed in using the REJECT control.

d. FREQUENCY CONTROLS

(1) FREQUENCY (switch)

The FREQUENCY selector switch selects the operating frequency for the unit in use. The selected frequency normally corresponds to the operating frequency of the transducer (search unit) being used. The various frequencies available are listed in Table 6-1. (In the HFN unit there is no FREQUENCY switch; its functions are performed by the individual plug-in tuning circuit boards.)

e. TEST CONTROLS

(1) TEST (switch)

The TEST switch is a two position switch which selects one of two possible test modes, THRU and NORMAL. In the THRU position two transducers (search units) are used, one transmits the high frequency pulse to the test specimen, the other receives the signals from the test specimen and sends pulses to the RF Amplifier via the RECEIVER jack. In the NORMAL position, only one transducer is used, and this acts as both transmitter and receiver of the high frequency pulse.

f. RECEPTACLES

(1) RECEIVER (left)

The left receptacle marked "R" is used under the following conditions:

- (a) When testing with pulse-echo (one transducer or search unit - TEST switch on NORMAL) technique and using quartz or lithium sulfate transducers with short cable.
- (b) Receiver cable is plugged in here when using through transmission technique (two transducers - TEST switch on THRU).

(2) TRANSMITTER (right)

The right receptacle marked "T" is used under the following conditions:

- (a) When testing with pulse-echo (one transducer) technique and using barium titanate, lead zirconate, or lead metaniobate types, or when cable is longer than 6'4".

- (b) Transmitter cable is plugged in here when using through transmission technique.

2. FAMILIARIZATION (Figure 6-1, 6-2 and 6-3)

a. FAMILIARIZATION - GENERAL

The detailed discussion of operating techniques given in the Familiarization Section of this manual should be consulted to supplement the basic information given here.

- (1) Assemble a Search Unit, a UM Reflectoscope complete with Time Control Unit, Display Unit, and Pulser/Receiver, and a test specimen.

NOTE

Always turn power off when plugging components in or taking them out.

- (2) Make sure that the Pulser/Receiver is set to the proper operating frequency. This is determined by the operating frequency of the search unit being used.
 - (a) With the 5B, 1N, 2.25N, 5N, and 10N units, this is accomplished with the FREQUENCY switch (figure 6-1).
 - (b) With the HFN unit, operating frequency is set by insertion of the proper plug-in tuning circuit board (figure 6-3). When the board is seated, the selected frequency will appear in the small window on the front panel (figure 6-2).
- (3) Obtain a trace on the CRT with the initial pulse and an echo pulse from the test specimen appearing on it.
 - (a) Move the COARSE SENSITIVITY switch (no switch on HFN unit) from X.1 to X1 to X10 and note that the amplitudes of the signals increase in broad steps.
 - (b) Turn the FINE SENSITIVITY control and note that it will control the amplitude of the signals within the ranges set by the COARSE switch. As the COARSE switch is moved from X.1 to X10 it will be necessary to decrease the FINE control to maintain a normal signal amplitude on the screen.

- (4) Manipulate the PULSE LENGTH and PULSE TUNING controls and note their effects. The LENGTH control will affect the signal amplitude and will also affect the width of the initial pulse and echo signal. The amplitude will increase with increased width. (Since increasing the width of the initial pulse may obscure echo signals from discontinuities close to the entrant surface, the PULSE LENGTH control should be used with discretion and increased only when the sensitivity controls cannot provide sufficient signal amplitude.) Note that signal amplitude and appearance can be improved by use of the PULSE TUNING control: this "trims" the Pulser/Receiver for optimum operation with a given cable and transducer.
- (5) With the REJECT control CCW, note that the sweep outside of the initial pulse and echo signals tends not to be "clean". Small random signals from the test specimen and noise signals from the unit ("grass") appear all along the sweep. By adjusting the REJECT control CW it should be possible to clean up the sweep by eliminating all but the initial pulse and desired echo signal.
- (6) Before attempting to test under specific requirements, study carefully the information on operating techniques given in the forward section of this manual and be sure to familiarize yourself with any accessory or recording equipment being used with the Reflectoscope.

PRINCIPLES OF OPERATION

1. GENERAL

Figure 6-4 is a block diagram of a Pulser/Receiver unit which is typical for all except the early 5B unit; however, the 5B unit is not markedly different. An overall schematic of the 5B is provided in the rear of this section, and Table 6-2 in the rear of the Principles of Operation summarizes the small design differences between all the Pulser/Receiver types.

The trigger amplifier receives a timing signal from the Time Control Unit and shapes and amplifies it. It then furnishes a 200 volt positive trigger signal to the pulser circuit.

When it is triggered the pulser circuit furnishes a high frequency pulse which is sent to the transducer through either the "R" or "T" jack, depending on the position of the TEST switch and the requirements of the test situation. High plate voltage (1000 volts) for the pulser thyratron is provided by the high voltage rectifier and step-up transformer. The time delay relay provides for warm-up before the high voltage is applied.

The frequency selector switch (or plug-in board with the HFN) places the proper amount of inductance in the resonant circuit of the pulser for the chosen operating frequency.

The echo pulse, either from the one transducer with pulse-echo or "normal" technique, or from the receiving transducer with through transmission technique, is applied to the input of the RF Amplifier through either the "T" or "R" jack and the TEST switch.

The RF Amplifier amplifies the high frequency echo pulses through four stages of amplification. The frequency selector selects the proper amount of tuning inductance for the four stages at the chosen operating frequency. The gain of the RF amplifier is controlled in steps by the COARSE SENSITIVITY switch (no switch on the HFN) and continuously by the FINE SENSITIVITY control.

The amplified high frequency pulse is applied to the video detector circuit where it is converted to a video pulse. The REJECT control sets the point at which the detector will not pass low level signals and allows only echo signals exceeding the set level to pass to the limiter and output circuit.

The limiter and output circuit limits the maximum signal strength which will be passed (6 volts in the 5B, 1N, 2.25N, and 5N; adjustable in the 10N and HFN) to insure an on screen signal top, and provides low impedance coupling of the video signal to the video gate in the Time Control Unit.

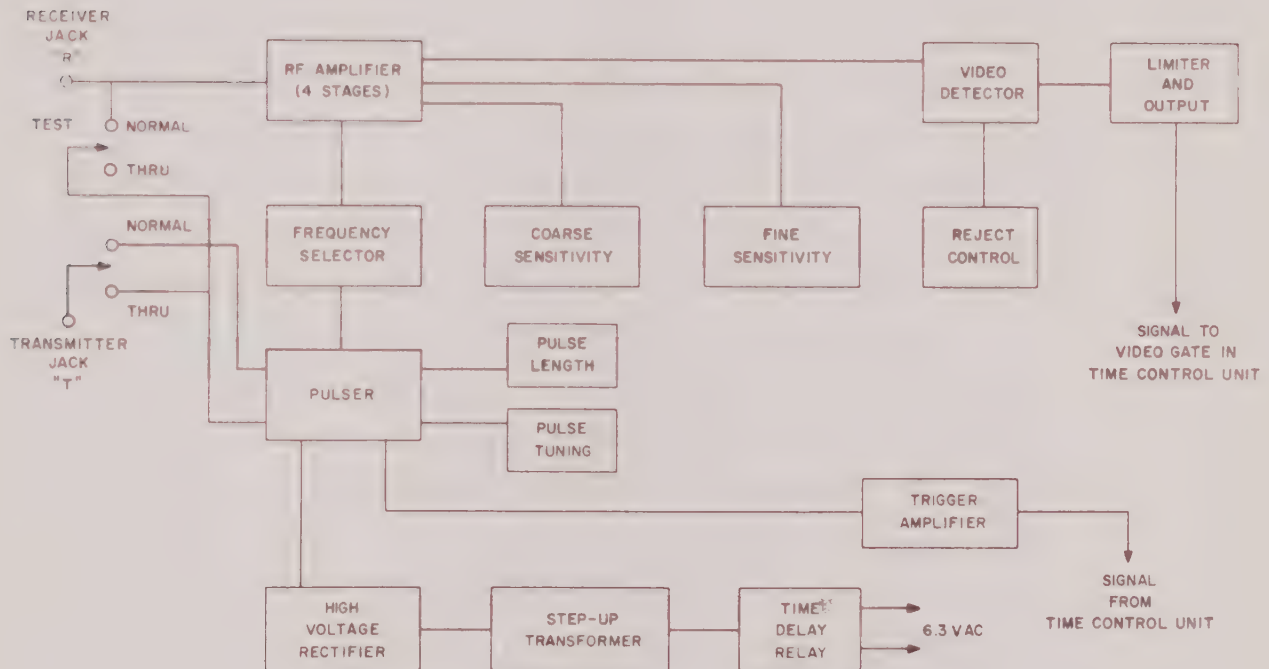


Figure 6-4
Block Diagram of Pulser/Receiver 5N (Typical)

2. DETAILED THEORY

During the following discussion reference should be made to the overall schematic of the 5N unit as typical. Table 6-2, at the end of this discussion, summarizes the major differences between types, and the more important differences are spelled out in the discussion. (The numbers in triangles on the schematic refer to the waveshapes contained in Section VII.)

The timing waveform (sync) from the Time Control Unit is brought in at pin 24 of J101 and is applied to the differentiating network C116 and R132. The square wave is differentiated to produce a peaked wave. The grid (pin2) of V101A is held at a positive potential by the resistive divider R133 and R132 so that only the negative going excursion is passed through amplifier V101A. This produces a positive going trigger pulse at the plate of V101A which is RC coupled to the grid (held at a negative reference level through R138) of cathode follower V101B. The cathode follower produces a sharply defined positive going 200 volt trigger pulse at pin 8 which is applied to the grid of pulse thyatron V102. This trigger pulse is coincident with the leading edge of the negative half-cycle of the timer square wave.

Thyatron pulser V102 produces high frequency pulses which, through capacitor C118, are applied to the search unit (transducer) through J102 or J103 depending on the position of the TEST switch S103 and the demands of the testing situation. The repetition rate of the pulses is, of course, controlled by the timing signal from the Time Control Unit as described in the above paragraph. The frequency of the oscillations within the pulse and the pulse duration are established by a resistive, capacitive, and inductive network comprised of R129, PULSE LENGTH; C115, PULSE TUNING; and either L105, L106, or L107, depending on the position of FREQUENCY selector switch S101. (In the HFN unit, the amount of inductance is determined by the plug-in tuning board selected.) In addition to forming part of the ringing or resonant circuit for the pulser, L105, L106, or L107 couples the output pulse to the transducer and the return or echo

pulse to the RF Amplifier by autotransformer action. PULSE TUNING capacitor C115 is in parallel with the resonant circuit and trims the circuit to compensate for transducer and cable differences. PULSE LENGTH potentiometer R129 is also in parallel with the resonant circuit and affects the Q or ringing time and therefore the pulse duration or width.

Pulser tube V102 operates at a relatively high plate voltage of 1000 volts. Time delay relay K101, step-up transformer T101, and the full wave rectifier comprised of CR103, CR104, CR105 and CR106 combine to help supply the 1000 volts. The time delay permits sufficient warm-up before the high plate voltage is applied to the tube. T101 steps up the 6.3vac which is then rectified. Filtering is accomplished by capacitors C119 and C120 and resistors R140 and R145. The output of the rectifier is 700 volts, but since one side is referenced to the 300 volts B+ derived from the Display Unit the effective plate voltage for V102 is 1000 volts. (Should K101 fail the pulser will still operate but with reduced signal strength.)

The RF Amplifier comprised of V103, V104, V105, and V106 (heaters operating on 12 volts direct current) accepts return or echo signals from the transducer and, after amplifying them through four stages, delivers them to the video detector. The RF Amplifier is synchronously tuned and employs L-C coupling between stages - C101, C102, C103, C104, and proper inductance for the chosen operating frequency as selected by FREQUENCY selector switch sections S101-3F, S101-3R, S101-4F, and S101-4R. (In the HFN unit the amount of inductance is determined by the plug-in circuit board selected.)

All units have a COARSE and FINE SENSITIVITY control except the HFN and 5B which have only a FINE SENSITIVITY control. The COARSE control is switch S102 which provides jump steps in amplifier gain by switching in varying amounts of resistance to shunt the inductance in the L-C coupling between the first and second stages of amplification. The controls (R110 and R131) are factory set to give X.1 and X1 ranges - the X10 range has no shunting resistance.

FINE SENSITIVITY control R105 is a potentiometer which with C121 forms a variable RC shunting circuit to ground for the RF signal.

The RF Amplifier delivers the amplified high frequency pulses to the video detector comprised of rectifier diode CR101, impedance matching emitter follower Q102, REJECT control R127, and filter circuit L108 and C123. Conventional detection is performed to obtain a video pulse from the high frequency pulse. At this point in the signal path it is desirable to be able to establish a variable reference point below which low level signals may be rejected so that the video trace may remain "clean" for ease of interpretation of signals. This is accomplished by REJECT control R127 (R147 on the 10N and R137 on the HFN) which is in series with R141 across a positive and negative voltage source. This enables the wiper of R127 to be varied from slightly positive to relatively highly negative which in turn swings CR101 from a slightly forward biased condition to a negatively biased condition. With maximum negative bias only relatively high level signals will be passed to the output circuit.

The video signals are passed to the limiter and output circuit of CR102 and Q101 from which they are passed to the video gate in the Time Control Unit via pin 19 on J101. CR102 is a 6 volt Zener diode which limits the amplitude of the video signals appearing at the base of Q101 and therefore of the signals appearing on the video trace in the Display Unit. This helps prevent misinterpretation of the trace because of large vertical displacements by high level signals. This limiting circuit is basically the same for the 1N, 2.25N, and 5N. The 10N and HFN are different in that a conventional diode is used and biased at a predetermined point to achieve the same effect. In both cases the action is variable; in the 10N the conduction of emitter follower Q103 is used to set the voltage at the junction between C122 and CR102 and this conduction in turn is regulated by the setting of R141, the potentiometer marked "clamp level set" on the schematic. In the HFN, potentiometer R130 forms part of a resistive divider and is used to set the bias on CR102. In the 10N and HFN an additional factory adjustment, R124 or R138, is added so that optimum conditions can be set in the circuit.

TABLE 6-2

SUMMARY OF MAJOR DIFFERENCES -- REFERENCED TO 5N

CIRCUIT	1N	2, 25N	10N	HFN
Trigger Amplifier (V101)	Same	Same	Same	Same
Pulser (V102)	Plate Resistor changed. C118 changed. L105, 106, 107 inductance value changed. PULSE LENGTH control same.	Plate Resistor changed. C118 changed. L105, 106, 107 inductance value changed. PULSE LENGTH control same.	Plate Resistor same. Capacitor selected by S101. L105, 106, 107 inductance value changed. PULSE LENGTH control changed.	Plate Resistor changed. Capacitor part of plug-in board. Inductance for resonant circuit on plug-in board. PULSE LENGTH control changed.
RF Amplifier (V103, V104, V105, V106)	Inductance values changed. Capacitance added to tuning circuits. COARSE SENSITIVITY same. V103, V104 same.	Inductance values changed. No added capacitance. COARSE SENSITIVITY same. V103, V104 same	Inductance values changed. No added capacitance. COARSE SENSITIVITY same V103, V104 same.	Inductance on plug-in circuit board. No added capacitance. No COARSE SENSITIVITY control. V103, V104 high performance tubes.
Video Detector (CR101, Q102)	Same.	Same.	Bias adjust added.	Bias adjust added.
Limiter and output circuit (CR102, Q101)	Same.	Same.	Limiting circuit changed.	Limiting circuit changed.

PULSER/RECEIVER UNIT

CONTROL

SETTINGS

CONTROL

SETTINGS

PULSE LENGTH

CCW

COARSE SENSITIVITY

X1

PULSE TUNING

MID RANGE

FINE SENSITIVITY

MID RANGE

REJECT

CCW

FREQUENCY

OPTIONAL

TEST

NORMAL

FREQUENCY (HFN)

BOARD IN

PULSER/RECEIVER UNIT IRREGULAR OR INOPERATIVE

Check that unit is properly in place, UM Reflectoscope is operating properly, cables are connected and firmly seated, controls on Pulser/Receiver are set as above.

Remove Pulser/Receiver and visually inspect for loose or missing tubes or transistors, poor connections on wires or components, burned components, or other obvious trouble.

Weak video signal

No video signal

Wrong frequency selected for transducer, or defective transducer.

TEST switch in wrong position.

On HFN, plug-in board not seated.

Defective Time Control or Display unit. Check waveform on pin 19, J101.

Time Delay Relay K101 defective.

On HFN, plug-in board not seated.

H. V. Rectifier circuit defective.

Check tubes, transistors, supply voltages and waveshapes

Check tubes, transistors, supply voltages and waveshapes

MODEL 5NRF

1. GENERAL

The 5NRF Pulser/Receiver unit will provide the same ultrasonic testing performance as the model 5N Pulser/Receiver, with the exception that the output echo signals to the CRT display are radio frequency (RF) signals rather than video (filtered unidirectional pulses). The amplified RF echoes appear on the CRT display identical to the signals received in the search unit. By utilizing this method, complete signal analysis is obtained for critical applications. The video would essentially provide the same information with the exception that the video filter reduces the frequency response and removes important signal features required for effective signal analysis.

2. CIRCUIT DESCRIPTION

The 5NRF uses circuitry identical to the 5N except for the fourth RF amplifier and output stages. The fourth RF amplifier utilizes tuning coils connected directly to the plate of the vacuum tube. Signals are capacitor coupled through C114 and C109 to two separate detector circuits. The purpose of the two detectors is to provide reject control. Each half of the signal has the lower portion clipped equally as the reject control is turned clockwise. These detected signals are impedance matched to the output through emitter followers Q101 and Q102. The positive and negative halves are integrated by the summing network R114 and R126 for providing bi-directional RF signals at the output.

MODIFICATIONS

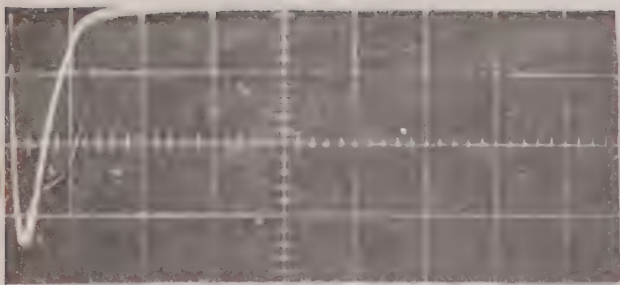
1. GENERAL

Minor modifications are required on all Pulser/Receiver units bearing serial numbers below S500 to provide overall compatibility when used with the UM715 and UM721 Reflectoscopes. All subsequent Pulser/Receiver models will contain these modifications; however, it is recommended that the units be inspected to verify incorporation of these changes prior to initial operation.

2. PROCEDURE

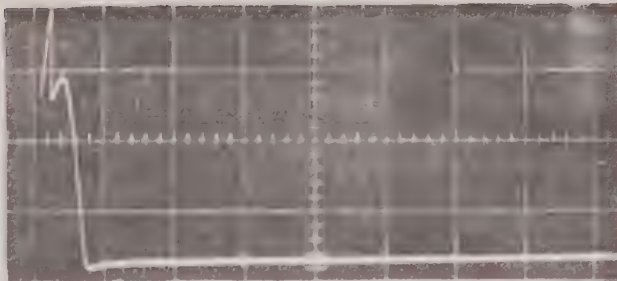
Modify the Pulser/Receiver unit as follows:

- a. Connect jumper from pin 8 to pin 19 on jack J101 of the Pulser/Receiver unit.
- b. Change Capacitor C116 (capacitor C101 in Pulser/Receiver Model HFN only) from 100 pf to 300 pf.



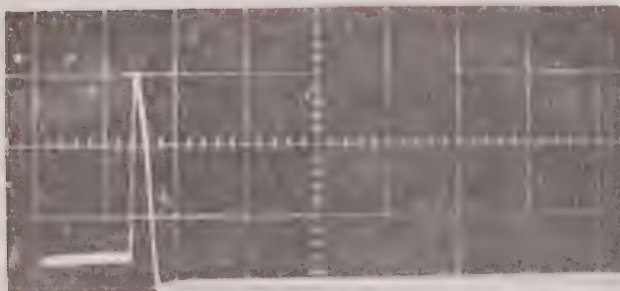
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TEST POINT: V101, pin 2
TIME/CM: 10 microsec
VOLTS/CM: 1
BASE LINE: 0 Volts



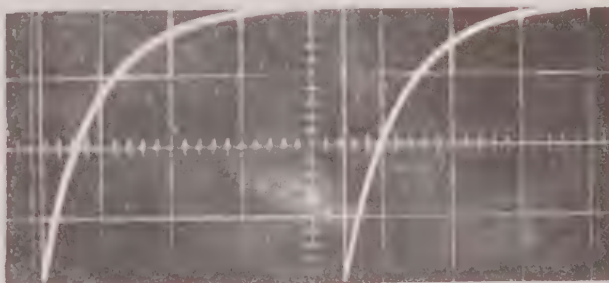
2

TEST POINT: V101, pin 6
TIME/CM 10 microsec
VOLTS/CM: 20
BASE LINE: +5 Volts



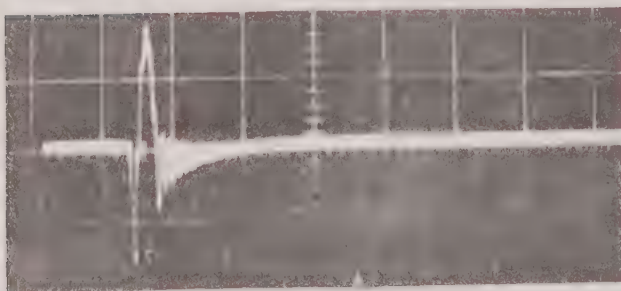
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TEST POINT: V102, pin 1
TIME/CM: 0.5 microsec
VOLTS/CM: 100
BASE LINE: 0 Volts



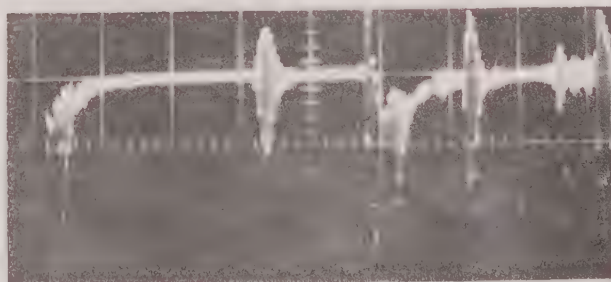
4

TEST POINT: V102, pin 6
TIME/CM: 0.5 millisecc
VOLTS/CM: 200



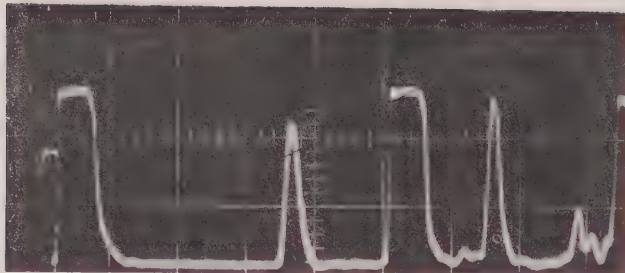
5

TEST POINT: R Jack J102
TIME/CM: 0.5 microsec
VOLTS/CM: 1



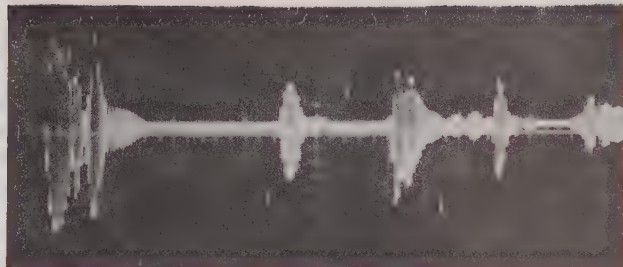
6

TEST POINT: V106, pin 5
TIME/CM: 5 microsec
VOLTS/CM: 10
BASE LINE: +130 Volts



7

APPLICATION: All models
except 5NRF
TEST POINT: J101, pin 19
TIME/CM: 5 microsec
VOLTS/CM: 2



8

APPLICATION: Model 5NRF only
TEST POINT: J101, pin 19
TIME/CM: 5 microsec
VOLTS/CM: 5
BASE LINE: +0.2 Volts

PARTS LIST
PULSER/RECEIVER UNIT 5N
Reference Schematic 50C361

Schematic Symbol No.	Sperry Part No.	Description
C101	DQG002A04	Capacitor .1uf 200v
C102	DQG002A04	Capacitor .1uf 200v
C103	DQJ002A37	Capacitor 500uuf 600v
C104	DQJ002A37	Capacitor 500uuf 600v
C105	DQG005A02	Capacitor .01uf 200v
C106	DQG005A02	Capacitor .01uf 200v
C107	DQG001B05	Capacitor 2 x .01uf 600v
C108	Cornell Dubilier	Capacitor 2 x .01uf 600v
C109	Cornell Dubilier	Capacitor 15uf 25v NL15-25
C110	DQG005A02	Capacitor .01uf 200v
C111	Sprague	Capacitor .005uf 50v 125L-D50
C112	ARCO	Capacitor .0033uf $\pm$ 10% 6DP-1-332
C113	Sprague	Capacitor .005uf 50v 125L-D50
C114	Sprague	Capacitor .1uf 50v TG-P10
C115	DQE001A07	Capacitor 7.5 - 100uuf 1200v
C116	DQJ002A32	Capacitor 300uuf 600v
C117	DQJ002A22	Capacitor 100uuf 600v
C118	Cornell Dubilier	Capacitor .002uf 1600v DPMS16D2
C119	DQL001A63	Capacitor 4uf 450v
C120	DQL001A63	Capacitor 4uf 450v
C121	DQG005A02	Capacitor .01uf 200v
C122	Sprague	Capacitor .1uf 50v TG-P10
C123	DQJ002A37	Capacitor 500uuf 600v
C124	Sprague	Capacitor 15uuf 5GA-Q15
C125	DQG001B05	Capacitor .1uf 400v
C126	Cornell Dubilier	Capacitor 2 x .01uf 600v BYD6DS1
C127	DQG005A02	Capacitor .01uf 200v
C128	Sprague	Capacitor .005uf 50v 125L-D50
C129	DQJ004A26	Capacitor 47uuf 600v
C130	DQG005A02	Capacitor .01uf
CR101	1N270	Diode
CR102	Hoffman Electronics	Diode 1N709A
CR103	Solitron Devices, Inc.	Diode CER-72
CR104	Solitron Devices, Inc.	Diode CER-72
CR105	Solitron Devices, Inc.	Diode CER-72
CR106	Solitron Devices, Inc.	Diode CER-72
R101	Willrite Prod., Inc.	Resistor 2K 1/2W $\pm$ 1% Type CMCS
R102	DPA005B09	Resistor 470 ohms 1/2W
R103	DPA005B09	Resistor 470 ohms 1/2W
R104	DPA009B09	Resistor 470 ohms 2W
R105	50A2478	Potentiometer 2.5K
R106	DPA004C12	Resistor 3K 1/2W
R107	DPA004C15	Resistor 3.9K 1/2W
R108	DPA009D01	Resistor 10K 2W
R109	DPA005D01	Resistor 10K 1/2W
R110	Allen Bradley	Potentiometer 500 ohms 1/4W $\pm$ 10% Type "R"
R111	DPA005D01	Resistor 10K 1/2W
R112	DPA005D01	Resistor 10K 1/2W
R113	DPA005D01	Resistor 10K 1/2W
R114	Willrite Prod., Inc.	Resistor 150 ohms 1/2W $\pm$ 1% Type CMCS
R115	DPA006C08	Resistor 2K 1W $\pm$ 5%
R116	DPA005A02	Resistor 12 ohms 1/2W
R117	DPA005A02	Resistor 12 ohms 1/2W
R118	DPA005A02	Resistor 12 ohms 1/2W
R119	Willrite Prod., Inc.	Resistor 10K 1/2W $\pm$ 1% Type CMCS
R120	DPA004A .1	Resistor 68 ohms 1/2W
R121	DPA004A21	Resistor 68 ohms 1/2W
R122	DPA004B08	Resistor 200 ohms 1/2W
R123	DPA004B03	Resistor 120 ohms 1/2W
R124	DPA004C15	Resistor 3.9K 1/2W
R125	DPA005C01	Resistor 1K 1/2W
R126	Willrite Prod., Inc.	Resistor 100 ohms 1/2W $\pm$ 1% Type CMCS
R127	DPG007J09	Potentiometer 10K Taper U
R128	DPA004A11	Resistor 27 ohms 1/2W
R129	DPG007B09	Potentiometer 10K Taper A
R130	DPA006B11	Resistor 270 ohms 1W
R131	Allen Bradley	Potentiometer 500 ohms 1/4W $\pm$ 10% Type 'R'

PULSER/RECEIVER UNIT 5N (cont)

Schematic Symbol No.	Sperry Part No.	Description
R132	DPA005D01	Resistor 10K 1/2W
R133	DPA005F01	Resistor 1Meg 1/2W
R134	DPA005D01	Resistor 10K 1/2W
R135	DPA006E05	Resistor 150K 1W
R136	DPA008E09	Resistor 220K 2W
R137	DPA005B05	Resistor 220 ohms 1/2W
R138	DPA005F01	Resistor 1 Meg 1/2W
R139	DPA005D01	Resistor 10K 1/2W
R140	DPA006E18	Resistor 510K 1W
R141	DPA004D11	Resistor 27K 1/2W
R142	Not Used	
R143	DPA007C01	Resistor 10K 1W
R144	Willrite Prod., Inc.	Resistor 40 ohms 1/2W $\pm 1\%$ Type CMCS
R145	DPA006E18	Resistor 510K 1W
R146	DPA004B13	Resistor 330 ohms 1/2W
L101	50A2303	Amplifier Coil Assembly
L102	50A2584	Amplifier Coil Assembly
L103	50A2303	Amplifier Coil Assembly
L104	50A2303	Amplifier Coil Assembly
L105	50B764	Pulse Coil
L106	50B765	Pulse Coil
L107	50B766	Pulse Coil
L108	C. T. C.	RF Choke 150uh X20829
V101	6U8A	Tube
V102	VC1258	Tube
V103	6DK6	Tube
V104	6DK6	Tube
V105	6DK6	Tube
V106	6DK6	Tube
S101	50B768	Switch and Coil Assembly
	50B825	Switch Section
S102	Stackpole	Switch, 3 position maintained Type SS-31
S103	Stackpole	Switch, DP-DT maintained Type SS-33
T101	50B755	Transformer
K101	Amperite	Relay 6N030T
Q101	2N585	Transistor
Q102	2N585	Transistor
J101	CQC017P01	Plug
J102	Greomar Mfg. Co.	Receptacle 6804
J103	Greomar Mfg. Co.	Receptacle 6804
	Zierick	Terminal, 3/8 hole #334
	Tektronix	Sleeve #861-008
	Tektronix	Terminal Strip, 3 notch #124-092
	Tektronix	Terminal Strip, 5 notch #124-093
	Tektronix	Terminal Strip, 7 notch #124-094
	Tektronix	Terminal Strip, 11 notch #124-106
	Southco	Fastener #48-10-102-10
	DTB019A01	Transistor Socket
	DTB013B03	Tube Socket
	DTB013A02	Tube Socket
	DTB014A02	Tube Socket
	DTB014B02	Tube Socket
	DTD003A02	Dial Knob
	DTD004A04	Knob
	50A2301	Knob

PULSER/RECEIVER UNIT 1N

Reference Schematic 50C529

Note: All components same as 5N except those listed below

Schematic Symbol No.	Sperry Part No.	Description
C109	Cornell Dubilier	Capacitor 25uf 25v NL15-25
C112	ARCO	
	6DP-1-332	Capacitor .0033uf $\pm 10\%$
C116	DQB006B34	Capacitor 300pf
C118	Cornell Dubilier	Capacitor .004uf 600v DPMS16D4
C123	Elmenco	Capacitor 1500uuf 500v CM20E152
C126	DQB006B48	Capacitor 1200uuf 500v
C127	Elmenco	Capacitor 620uuf 500v CM20E621
C129	DQB006B48	Capacitor 1200uuf 500v
C130	Elmenco	Capacitor 620uuf 500v CM20E621
C131	Cornell Dubilier	Capacitor 2 x .01uf 600v BYD6DS1
C132	Sprague	Capacitor .005uf 50v 125L-D50
C133	DQJ004A26	Capacitor 47uuf 600v
C134	DQB006B32	Capacitor 240uuf 500v
C135	DQB006B32	Capacitor 240uuf 500v
C136	DQB006B21	Capacitor 82uuf 500v
C137	DQB006B30	Capacitor 200uuf 500v
C138	DQB006B37	Capacitor 390uuf 500v
C139	DQB006B34	Capacitor 300pf 500v
C140	DQB006B27	Capacitor 150uuf 500v
C141	DQB006B18	Capacitor 62pf 500v
R119	DPA005D01	Resistor 10K 1/2W
R122	DPA004B08	Resistor 200 ohms 1/2W
R126	DPA004B02	Resistor 100 ohms 1/2W
R136	DPA008E06	Resistor 100K 2W
R147	DQG007J09	Potentiometer 10K Taper U
R148		Resistor 15 ohms 1/2W
L101	50B927	Amplifier Coil Assembly
L102	50B927	Amplifier Coil Assembly
L103	50B986	Amplifier Coil Assembly
L104	50B986	Amplifier Coil Assembly
L105	50B967	Pulse Coil
L106	50B824	Pulse Coil
L107	50B764	Pulse Coil
	C. T. C.	RF Choke 330uh X2082-11

PULSER/RECEIVER UNIT 2.25N

Reference Schematic 50C391

Note: All components same as 5N except those listed below.

C107	DQG001B05	Capacitor .1uf
C108	Cornell Dubilier	Capacitor 2 x .01 600v DYD6DS1
C112	ARCO	
	6DP-1-332	Capacitor .0033uf $\pm 10\%$
C118	Cornell Dubilier	Capacitor .004uf 1600v DPMS16D4
C126	DQB005B34	Capacitor 200uuf
C127	DQB002B32	Capacitor 4700uuf
C128	DQG005A02	Capacitor .01uf 200v
C129	DQB005B34	Capacitor 200uuf
C130	DQB005B34	Capacitor 200uuf
C131	Cornell Dubilier	Capacitor 2 x .01uf 600v BYD6DS1
C132	Sprague	Capacitor .01uf 50v 125L-S10
C133	DQJ004A26	Capacitor 47uuf 60 v
C135	DQG005A02	Capacitor .01uf
R122	DPA004B09	Resistor 220 ohms 1/2W
R147	DPA004B13	Resistor 330 ohms 1/2W
L102	50A2585	Amplifier Coil Ass mbly
L105	50B824	Pulse Coil
L106	50B764	Pulse Coil
L107	50B765	Pulse Coil

PULSER/RECEIVER UNIT 10N
Reference Schematic 50C519

Note: All components same as 5N except those listed below.

Schematic Symbol No.	Sperry Part No.	Description
C109	DQB005C37	Capacitor 250uuf 500v
C111	Sprague	Capacitor .005uf 50v TG-D50
C112	DQB005C04	Capacitor 5uuf 500v
C113	Sprague	Capacitor .005uf 50v TG-D50
C122	DQL002A10	Capacitor 25uf 25v
C123	DQB005C08	Capacitor 18uuf 500v
C124	Sprague	Capacitor .005uf 50v TG-D50
C131	Sprague	Capacitor .005uf 50v TG-D50
C132	DQG001B06	Capacitor .25uf 400v
C133	DQG001B06	Capacitor .25uf 400v
C134	DQG001B06	Capacitor .25uf 400v
CR102	Transitron	Diode SG555
R101	Willrite Prod., Inc	Resistor 2K 1/2W $\pm$ 10% Type CMCS
R114	DPA005E01	Resistor 100K 1/2W
R115	DPA006A08	Resistor 2K 1W $\pm$ 5%
R119	Willrite Prod., Inc.	Resistor 10K 1/2W Type CMCS
R124	Bourns	Potentiometer 1 Meg 2155-1-105
R125	DPA005C01	Resistor 1K 1/2W
R126	DPA004B19	Resistor 560 ohms 1/2W
R127	DPA004C01	Resistor 1K 1/2W
R128	DOA004C08	Resistor 2K 1/2W
R130	DPA006B07	Resistor 180 ohms 1W
R137	DPA005B10	Resistor 560 ohms 1/2W
R140	DPA005F02	Resistor 1.2 Meg 1/2W
R141	Bourns	Potentiometer 5K 273-1-502
R142	DPA004D11	Resistor 27K 1/2W
R143	DPA007D01	Resistor 10K 1W
R145	DPA005F02	Resistor 1.2 Meg 1/2W
R146	DPA004C01	Resistor 1K 1/2W
R147	DPG007J09	Potentiometer 10K Taper U
R148	DPA004B06	Resistor 160 ohms 1/2W
R149	DPA004B09	Resistor 220 ohms 1/2W
R150	DPA004C01	Resistor 1K 1/2W
R151	DPA005C01	Resistor 1K 1/2W
L101	50B908	Amplifier Coil Assembly 10mc
L102	50B908	Amplifier Coil Assembly 10mc
L103	50B895	Amplifier Coil Assembly
L104	50B895	Amplifier Coil Assembly
L105	50B896	Pulse Coil
L106	50B766	Pulse Coil
L107	50B765	Pulse Coil
L108	C. T. C.	RF Choke 2082-13
L109	C. T. C.	RF Choke 2082-13
L110	C. T. C.	RF Choke 2082-13
L111	C. T. C.	RF Choke 2082-13
S103	Stackpole	Switch Type SS-34
Q103	2N44	Transistor

PULSER/RECEIVER UNIT HFN
Reference Schematic 50C390

Schematic Symbol No.	Sperry Part No.	Description
C101	DQJ002A22	Capacitor 100uuf 600v
C102	Sprague	Capacitor .01uf 500v 19C241
C103	DQB005B18	Capacitor 47uuf 600v
C104	DQB005B31	Capacitor 150uuf 500v
C105	DQG002B04	Capacitor .05uf 400v
C106	DWL001A63	Capacitor 4uf 450v

PULSER/RECEIVER UNIT HFN (cont)

Schematic Symbol No.	Sperry Part No.	Description
C107	DQL001A63	Capacitor 4uf 450v
C108	DQE001A07	Capacitor 7.5 - 100uuf 1200v
C109	Sprague	Capacitor .01uf 500v 19C241
C110	Sprague	Capacitor .01uf 500v 19C241
C111	Sprague	Capacitor .01uf 500v 19C241
C112	Sprague	Capacitor .01uf 500v 19C241
C113	Sprague	Capacitor .01uf 500v 19C241
C114	Sprague	Capacitor .01uf 500v 19C241
C115	Sprague	Capacitor .01uf 500v 19C241
C116	DQG001B05	Capacitor .1uf 500v
C117	Sprague	Capacitor .01uf 500v 19C241
C118	Sprague	Capacitor .01uf 500v 19C241
C119	DQB005B45	Capacitor 500uuf 500v
C120	DQE002A04	Capacitor .1uf 200v
C121	DQL001A18	Capacitor 10uf 25v
C122	DQG002B05	Capacitor .1uf 400v
C123	DQG002B05	Capacitor .1uf 400v
C124	DQB005B14	Capacitor 33uuf 500v
C125	Sprague	Capacitor .01uf 500v 19C241
C126	Sprague	Capacitor .01uf 500v 19C241
C127	Sprague	Capacitor .01uf 500v 19C241
C128	DQE002A04	Capacitor .1uf 200v
C129	DQE002A04	Capacitor .1uf 200v
C130	Not used	
C131	Sprague	Capacitor .01uf 500v 19C241
C132	Sprague	Capacitor 10uf 25vdc TE1204
CR101	Transitron	Diode SG555
CR102	Transitron	Diode SG555
CR103	Solitron Devices, Inc.	Diode CER-72
CR104	Solitron Devices, Inc.	Diode CER-72
CR105	Solitron Devices, Inc.	Diode CER-72
CR106	Solitron Devices, Inc.	Diode CER-72
R101	DPA005D01	Resistor 10K 1/2W
R102	DPA005F01	Resistor 1 Meg 1/2W
R103	DPA005D01	Resistor 10K 1/2W
R104	DPA006E05	Resistor 150K 1W
R105	DPA005F01	Resistor 1 Meg 1/2W
R106	DPA005D01	Resistor 10K 1/2W
R107	DPA008E13	Resistor 330K 2W
R108	DPA006E18	Resistor 510K 1W
R109	DPA006E18	Resistor 510K 1W
R110	DPG007B11	Potentiometer 2.5K
R111	DPA004B08	Resistor 200 ohms 1/2W
R112	DPA005D01	Resistor 10K 1/2W
R113	DPA005A02	Resistor 12 ohms 1/2W
R114	DPA004C03	Resistor 1.2K 1/2W
R115	DPA005D01	Resistor 10K 1/2W
R116	DPA005B09	Resistor 470 ohms 1/2W
R117	DPA005A02	Resistor 12 ohms 1/2W
R118	DPA005A05	Resistor 22 ohms 1/2W
R119	50A2734	Potentiometer 1K
R120	DPA005D01	Resistor 10K 1/2W
R121	DPA005B09	Resistor 470 ohms 1/2W
R122	DPA004C07	Resistor 1.8K 1/2W
R123	DPA005D01	Resistor 10K 1/2W
R124	DPA004B03	Resistor 120 ohms 1/2W
R125	DPA006B17	Resistor 470 ohms 1W
R126	DPA004C17	Resistor 4.7K 1/2W
R127	DPA005D01	Resistor 10K 1/2W
R128	DPA004B03	Resistor 120 ohms 1/2W
R129	DPA004C09	Resistor 2.2K 1/2W
R130	Bourns	Potentiometer 100 ohms 273-1-101
R131	DPA005D12	Resistor 82K 1/2W
R132	DPA004A19	Resistor 56 ohms 1/2W
R133	DPA005C05	Resistor 2.2K 1/2W
R135	DPA004A19	Resistor 56 ohms 1/2W
R136	DPA005B09	Resistor 470 ohms 1/2W
R137	DPG007H10	Potentiometer 5K

PULSER/RECEIVER UNIT HFN (cont)

Schematic Symbol No.	Sperry Part No.	Description
R138	Bourns	Potentiometer 5K 273-1-502
R139	DPA004C08	Resistor 2K 1/2W
R140	DPA004B15	Resistor 390 ohms 1/2W
R141	Not used	
R142	DPA009C11	Resistor 6.8K 2W
R143	DPA007A08	Resistor 39 ohms 1W
L101	DRA003A05	Choke 33uh
L102	DRA003A05	Choke 33uh
L103	DRA003A05	Choke 33uh
V101	6U8A	Tube
V102	VC125B	Tube
V103	Raytheon	Tube CK6688
V104	Raytheon	Tube CK6688
V105	6DK6	Tube
V106	6DK6	Tube
S101	Stackpole	Switch Type SS-34
T101	50B755	Transformer
K101	Amperite	Relay 6N030T
Q101	2N502	Transistor
Q102	2N502	Transistor
J101	CQC017P01	Plug
J102	Gremar Mfg. Co.	Receptacle 6804
J103	Gremar Mfg. Co.	Receptacle 6804
J104	Elco	Connector 5009-13-2-5-3/32
J105	Elco	Connector 5009-13-2-5-3/32
	Tektronix	Sleeve #361-008
	Tektronix	Terminal Strip #124-092
	Tektronix	Terminal Strip #124-094
	Tektronix	Terminal Strip #124-106
	Southco	Fastener #48-10-102-10
	Southco	Side Rail Spring #90-0-5931-11
	DTB019A01	Transistor Socket
	DTB013A02	Tube Socket
	DTB013B03	Tube Socket
	DTB014A02	Tube Socket
	DTB014B02	Tube Socket
	DTB003A02	Dial Knob
	DTB004A04	Knob
	50A2301	Knob

10mc Plug-In Board:

	50A2827	Bracket Flag 10mc
	Elmenco	Capacitor .001uf 500v 3CCD-102
	DQB005B05	Capacitor 10uuf 500v
L104	50B957	Coil - Pulser - 10mc
L105	50B963	Coil - RF - 10mc
L106	50B963	Coil - RF - 10mc
L107	50B963	Coil - RF - 10mc
L108	50B960	Coil - RF - 10mc

15mc Plug-In Board:

	50A2828	Bracket Flag 15mc
	Elmenco	Capacitor .001uf 3000v 3CCD-102
L104	50B958	Coil - Pulser - 15mc
L105	50B964	Coil - RF - 15mc
L106	50B964	Coil - RF - 15mc
L107	50B964	Coil - RF - 15mc
L108	50B961	Coil - RF - 15mc

PULSER/RECEIVER UNIT HFN (cont)

Schematic Symbol No.	Sperry Part No.	Description
	25mc Plug-In Board:	
	50A2829	Bracket Flag 25mc
	Elmenco	Capacitor .001uf 3000v 3CCD-102
	50B959	Coil - Pulser - 25mc
L104	50B965	Coil - RF - 25mc
L105	50B965	Coil - RF - 25mc
L106	50B965	Coil - RF - 25mc
L107	50B966	Coil - RF - 25mc
L108	50B962	Coil - RF - 25mc

PULSER/RECEIVER UNIT 5NRF

Reference Schematic 50C703

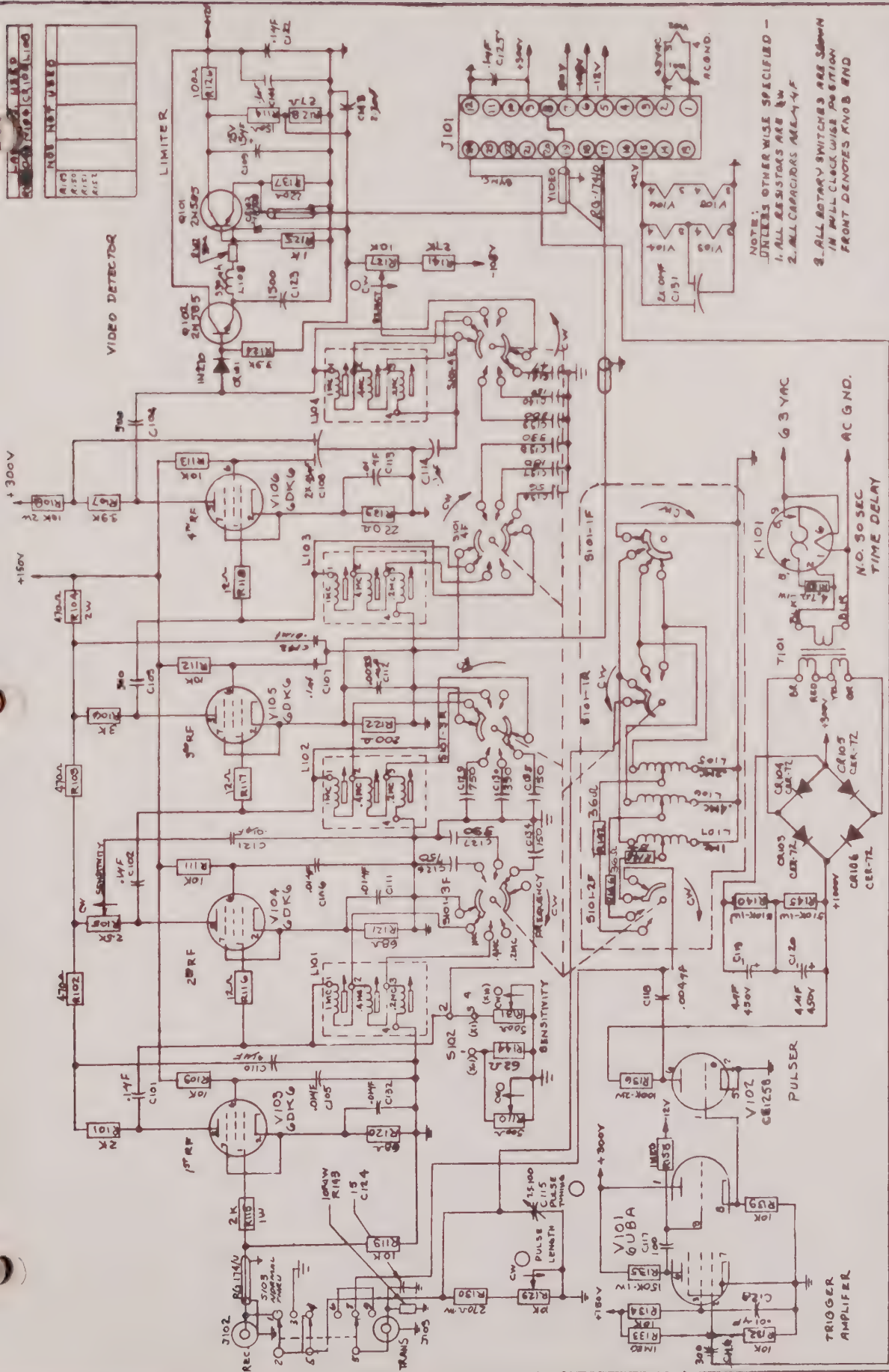
Schematic Symbol No.	Sperry Part No.	Description
C101	DQG002A04	Capacitor .1uuf 200v
C102	Same as C101	
C103	DQJ002A37	Capacitor 500uuf 600v
C105	DQG005A02	Capacitor .01uf 200v
C106	Same as C105	
C107	Same as C101	
C108	Cornell Dubilier	Capacitor 2 x .01uf 600v BYD6DS1
C110	Same as C105	
C111	Sprague	Capacitor .005uf 50v 125L-D50
C112	ARCO	Capacitor 3300uuf 600v 10% 6DP1-332
C113	Same as C111	
C115	DQE001A07	Capacitor 7.5-100uuf 1200v
C116	DQJ002A22	Capacitor 100uuf 600v
C117	Same as C116	
C118	Cornell Dubilier	Capacitor .002uf 1600v DPMS16D2
C119	DQL001A63	Capacitor 4uf 450v
C120	Same as C119	
C121	Same as C105	
C122	Sprague	Capacitor .1uf 25v 5C7
C124	Sprague	Capacitor 15uuf 5GA-Q15
C126	Same as C122	
C127	Same as C105	
C128	Same as C111	
C129	DQJ004A26	Capacitor 47uuf 600v
C130	Same as C105	
C131	Same as C122	
C132	Same as C122	
C133	Same as C122	
C135	Sprague	Capacitor .022uf 500v 5GAB-S22
C136	Sprague	Capacitor 10uf 150v TVA1406
CR103	Solitron Devices, Inc.	Diode CER-72
CR104	Same as CR103	
CR105	Same as CR103	
CR106	Same as CR103	
J101	CQC017P01	Plug
J102	Gremer Mfg. Co.	Receptacle
J103	Same as J102	
K101	Amperite	Relay 6N030T
L101	50A2303	Amplifier Coil Assembly
L102	50A2584	Amplifier Coil Assembly
L102A	C. T. C.	Coil X2060-6
L102B	C. T. C.	Coil X2060-8
L102C	C. T. C.	Coil X2060-10
L103	Same as L101	
L104	50A3153	Amplifier Coil Assembly
L104A	C. T. C.	Coil X2060-5
L104B	C. T. C.	Coil X2060-8
L104C	C. T. C.	Coil X2060-10
L105	50B764	Pulse Coil
L106	50B765	Pulse Coil
L107	50B766	Pulse Coil

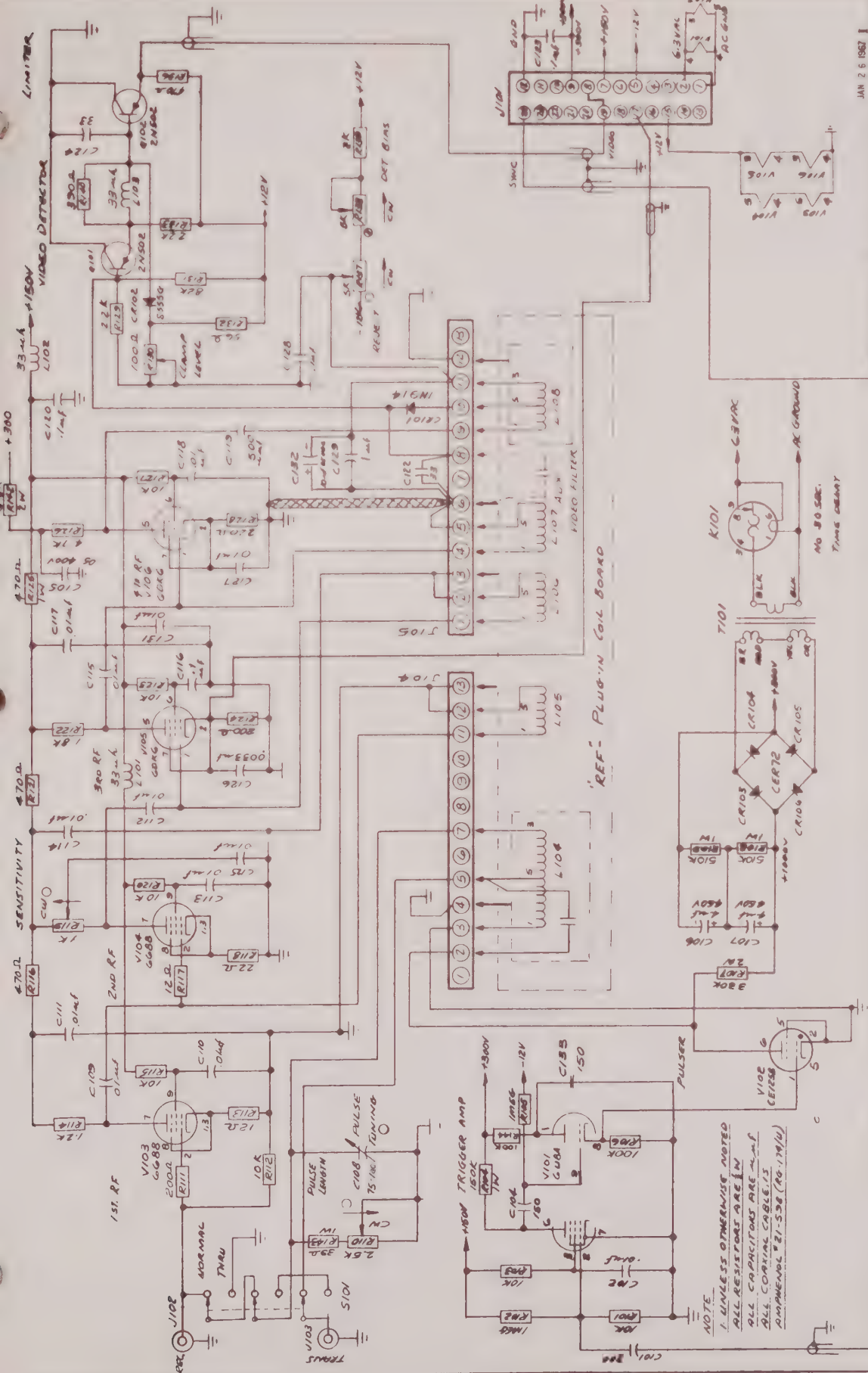
PULSER/RECEIVER UNIT 5NRF (cont)

Schematic Symbol No.	Sperry Part No.	Description
R101	Willrite Prod., Inc.	Resistor 2K 1/2W $\pm$ 1% Type CMCS
R102	DPA005B09	Resistor 470 ohms 1/2W 5%
R103	Same as R102	
R104	DPA009B09	Resistor 470 ohms 2W
R105	50A2478	Potentiometer 2.5K
R106	DPA004C12	Resistor 3K 1/2W 5%
R107	DPA004C09	Resistor 2.2K 1/2W 5%
R108	DPA005D01	Resistor 10K 1/2W
R109	Same as R108	
R110	Allen-Bradley	Potentiometer Type R
R111	Same as R108	
R112	Same as R108	
R115	DPA006C08	Resistor 2K 1W 5%
R116	DPA005A02	Resistor 12 ohms 1/2W
R117	Same as R116	
R118	Same as R116	
R119	Willrite Prod., Inc.	Resistor 10K 1/2W $\pm$ 1% Type CMCS
R120	DPA004A21	Resistor 68 ohms 1/2W 5%
R121	Same as R120	
R122	DPA004B08	Resistor 200 ohms 1/2W
R123	DPA004B03	Resistor 120 ohms 1/2W 5%
R127	DPG007C07	Potentiometer 50K Taper A
R129	DPG007B09	Potentiometer 10K Taper A
R130	DPA006B11	Resistor 270 ohms 1W 5%
R131	Same as R110	
R132	Same as R108	
R133	DPA005F01	Resistor 1 Meg 1/2W
R134	Same as R108	
R135	DPA006E05	Resistor 150K 1W
R136	DPA008E09	Resistor 220K 2W
R138	Same as R133	
R139	Same as R108	
R140	DPA006E18	Resistor 510K 1W
R143	DPA007D01	Resistor 10K 1W $\pm$ 10%
R144	Willrite Prod. Inc.	Resistor 40 ohms 1/2W $\pm$ 1% Type CMCS
R145	Same as R140	
R149	DPA007B09	Resistor 470 ohms 1W $\pm$ 5%
S101	50B757	Switch
S102	Stackpole	Switch SS-31
S103	Stackpole	Switch SS-33 DP-DT
T101	50B755	Transformer
V101	6U8A	Tube
V102	VC1258	Tube
V103	6DK6	Tube
V104	Same as V103	
V105	Same as V103	
V106	Same as V103	
	DTD003A02	Dial Knob
	DTD004A04	Knob
	Tektronix	Sleeve 361-008
	Tektronix	Terminal Strip 124-092
	Tektronix	Terminal Strip 124-094
	Tektronix	Terminal Strip 124-106
	DTB013B03	Tube Socket
	DTB013A02	Tube Socket
	DTB014A02	Tube Socket
	DTB014B02	Tube Socket

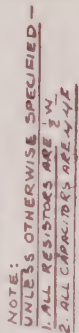
R. F. REJECT AND DRIVE P. C. BOARD
COMPONENT ASSEMBLY
Reference Schematic 50C703

Schematic Symbol No.	Sperry Part No.	Description
C104	Sprague	Capacitor .1uf 25v 5C7
C109	Sprague	Capacitor .1uf 500v 5HK-P10
C114	Same as C109	
C122	Same as C104	
C123	Same as C104	
C125	Same as C104	
C137	Centralab	Capacitor .01uf 1000v DD103
C138	Sprague	Capacitor .1uf 25 vdc 5C7
CR101	Transitron	Diode S555G
CR102	Same as CR101	
L108	C. T. C.	R. F. Choke 1uh 10% X2082-14
L109	Same as L108	
Q101	2N1308	Transistor
Q102	2N1309	Transistor
R113	DPA004C10	Resistor 2.4K 1/2W 5%
R114	DPA004A24	Resistor 91 ohms 1/2W 5%
R124	DPA004B11	Resistor 270 ohms 1/2W 5%
R125	DPA004C22	Resistor 7.5K 1/2W 5%
R126	Same as R114	
R128	DPA004C20	Resistor 6.2K 1/2W 5%
R137	Same as R125	
R141		Potentiometer 2.5K
R142	DPA004B01	Resistor 100 ohms 1/2W 5%
R146	Same as R125	
R147	DPA004C10	Resistor 2.4K 1/2W 5%
R148	DPA006B12	Resistor 300 ohms 1W 5%
	ELCO	Transistor Socket 3303



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3. ALL ROTARY SWITCHES ARE SHOWN
IN FULL CLOCKWISE POSITION.
FRONT DENOTES KNOB END.
* ALL CO-AXIAL CABLE IS RG-74/U

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INSTRUCTION MANUAL

FAST TRANSIGATE

TYPE 50C753

and

DUAL FAST TRANSIGATE

TYPE 50E621



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FAST TRANSIGATE - STYLE 50C753

DESCRIPTION

1. GENERAL

The Fast Transigate has been designed to plug into the Special Function Cabinet for operation with Type UM Reflectoscopes. Used in combination with other Special Function components or external monitoring equipment, the Fast Transigate provides flexibility in establishing ultrasonic inspection systems for semi-automatic or automatic detection of flaws in materials at production speeds. This is accomplished by setting up specific, controllable gated areas or zones within a test piece. Signals appearing within these gates may be monitored automatically to operate visual and/or aural alarms.



Figure 9-8
Front View of Fast Transigate

The Fast Transigate incorporates a single channel gate (adjustable in start and length) and a discriminator level set. An interface sync control may be used to lock the gate start position (and sweep circuits if timer marker switch is set to I.F. position) on the first signal received after the initial pulse (first echo signal - usually the entrant surface of the test piece.) Using immersed testing techniques, this assures

that any variation of water path distance (distance between the search unit and the surface of the test piece) will not affect the position of signals, markers, or gates appearing along the sweep. Visual and aural alarms are included in the form of a panel light and an internal buzzer. Output of recording and alarm information is also provided for operation of other Special Function components or for external control and recording devices.

The Fast Transigate may be disabled by a simple GATE OFF switch without disturbing other set-up conditions in the Special Function Cabinet or in the UM Reflectoscope. Additional Fast Transigates may be added to meet the requirements of tests where more than one area of a test piece is to be inspected in one pass or where response to more than one level within a single area is desired.

The Fast Transigate consists of the following major components:

a. ECHO GATE 50C1097

Printed circuit board containing circuitry for generation of the square wave used to establish the "gate" or "zone" and the gated video amplifier which passes signals from the UM Reflectoscope through the "zone" to the Recorder Board. Also sends gate image signal to UM Reflectoscope Display (figure 9-9).

b. RECORDER BOARD 50C385

Printed circuit board containing circuitry for accepting gated video from ECHO GATE, establishing DC level proportional to video signal amplitude, and furnishing amplitude and on-off signals to alarm circuitry, ALFAX Recorders, and penmotor type recorders.

c. ALARM BOARD 50C386

Printed circuit board containing circuitry for accepting alarm signals from RECORDER, functioning as automatic or manual reset device, and driving aural and visual alarm devices.

d. INTERFACE OR FIRST ECHO SYNC 50C387

Printed circuit board containing circuitry for gating video to eliminate main bang, generating trigger in response to first echo signal which is sent to ECHO GATE circuitry.

e. FRONT AND REAR PANEL ASSEMBLY

Structural portion of module which accepts individual circuit boards, containing audio and visual alarms and external controls on front panel and connectors for interconnecting Fast Transigate in Special Function Cabinet or in UM Reflectoscope.

2. MECHANICAL SPECIFICATIONS

The Fast Transigate plugs into the Special Function Cabinet and is easily disconnected for servicing or interchange. The following front panel controls are provided:

a. GATE CONTROLS:

START (pointer)
START (vernier)
LENGTH (pointer)
LENGTH (vernier)
GATE OFF and Indicator Lamp

b. ALARM CONTROLS:

LEVEL (vernier)
+ AUTO RESET (pointer)
- AUTO RESET (pointer)
+ MANUAL RESET (pointer)
- MANUAL RESET (pointer)
RESET LIGHT SWITCH
AUDIO ON-OFF

c. SYNC CONTROLS:

MAIN PULSE (pointer)
FIRST ECHO (pointer)
MARKER SHIFT (vernier)

3. ELECTRICAL SPECIFICATIONS

All power requirements are obtained from the UM Reflectoscope Display Unit.

4. GATES

Gate Start - .25 sec. to 300 u sec. (.035" to 30' in steel)
Gate Length - .25 u sec. to 1700 u sec. (.035" to 17' in steel)

5. RECORDING SIGNALS

- a. To operate strip-chart recorders on any signal appearing in the gated area, a DC recording signal (+12 to 0v) is provided that is proportional to the largest unsaturated signal in the gate. This signal has instantaneous response. Duration is equal to one repetition-rate cycle plus the time to the end of the next gate - or as long as signals remain in the gate.
- b. For purposes of selective alarming on signals that either exceed or fall below a set level (positive or negative response), the Fast Transigate provides a DC on-off signal (0 and -10 vdc). This can be used for facsimile recorders or for relay and solenoid operation.

6. RANGE OF LEVEL CONTROL

Range of the alarm LEVEL control is 1/8 in. to 3 in. (full scale).

7. OPERATING TEMPERATURE RANGE

Stable and reliable operation is provided over the range 0°F. to 120°F.

OPERATION

1. FUNCTION OF CONTROLS (Figure 9-8)

a. GATE CONTROLS (COMBINATION VERNIER AND POINTER)

(1) START (pointer)

Provides coarse positioning of the gate start (figure 9-9).

(2) START (vernier)

Permits fine, continuous control of the gate start position between the coarse ranges noted above.

(3) LENGTH (pointer)

A coarse control which sets the width (α length) of the gate figure 9-9 .

(4) LENGTH (vernier)

Provides a fine continuous control of gate width between the coarse ranges noted above.

(5) GATE OFF

Permits the disabling of gate without disturbing any of the variable controls. When the lamp is OFF, the gate is ON.

b. ALARM CONTROLS (COMBINATION VERNIER AND POINTER)

(1) LEVEL (vernier)

Establishes the signal level (on the UM Reflectoscope display) at which alarms, relays or on-off printing will be activated or initiated (figure 9-9).

(2) + AUTO RESET (pointer)

Sets up systems to alarm when any displayed signal within the gate (figure 9-9) increases above the level set by the LEVEL control. The alarm buzzer will sound and the panel light will remain on for a minimum of 0.1 sec., or as long as a signal above the level set remains in the gated area. Alarm circuits reset automatically when the signal decreases in amplitude below the alarm level, or is no longer in the gate.

(3) - AUTO RESET (pointer)

With the control in this position, the system is set to alarm when the signal within the gated area falls below the level set by the LEVEL control. Alarms will remain activated for a minimum of 0.1 sec., or as long as the signal remains below the level set in the gate. Alarm circuits reset automatically when the signal increases in amplitude above the alarm level.

(4) + MANUAL RESET (pointer)

This control position sets the system to alarm on any signal appearing in the gate having an amplitude greater than that set by the LEVEL control. The alarms (light and buzzer) will remain activated until reset manually by pressing the RESET light switch.

(5) - MANUAL RESET (pointer)

Sets the system to alarm when the signal appearing within the gated area falls below the level that has been pre-set by the LEVEL control. A single video pulse that drops below the level set will activate the alarms (buzzer and light) which must be reset manually by pressing the RESET light switch.

(6) RESET LIGHT SWITCH

The RESET light is activated by an alarm signal and remains on until reset automatically or manually as described above.

(7) AUDIO ON-OFF

This switch controls the buzzer alarm. If no audible alarm is wanted, this switch is set to OFF.

NOTE

In all of the above conditions (alarm, level and reset), an on-off type printing signal is available. The minimum duration of this signal is the period of one rep-rate plus the time to the end of the next gate, or as long as there is video present to maintain the signal. The start of printing is coincident with alarming. Output voltage is 0 to -8 volts. Output impedance is 1K ohms. Signal output is also available to drive low power relays or solenoids. This output is present as long as the alarm light is energized. Output is half wave, 60 cps at 8.8 volts peak. Output impedance is less than 50 ohms. See operation sections for Type S Recording Amplifier and Type R Relay Chassis.

c. SYNC CONTROLS

(1) MAIN PULSE (pointer)

With the control in this position, the start of the gate is

synchronized by the initial pulse or "main bang". The gate start is initiated by a trigger pulse that is coincident with, or slightly ahead of the leading edge of the initial pulse or "main bang".

(2) FIRST ECHO (pointer)

In this position, the system is synchronized by the first echo signal to appear - presumably the interface or entrant signal. When employing immersed testing techniques, this permits setting the gate to include only the material under test while ignoring signal variations caused by changing water path distance. Immediately after the "main bang", a delay is created during which no returning video can synchronize the ECHO GATE and marker circuits. This delay time (9 - 80 u sec) is adjustable by R504 (internal) on the INTERFACE SYNC board, and is factory set for 20 u sec. In some cases it may be necessary to adjust this delay beyond some fixed echo prior to interface.

c. FAMILIARIZATION (Figure 8-1, 9-8, and 9-9)

a. SET-UP

- (1) Assemble a Search Unit, UM Reflectoscope with Special Function Cabinet, and a test specimen.
- (2) Check that the Fast Transigate unit is in position and properly secured.
- (3) If a Type S Recording Amplifier or a Type R Relay Chassis is being used, check the OPERATION sections on these units for proper procedure.
- (4) Turn on the UM Reflectoscope and with GATE control on Fast Transigate to ON obtain a video trace and marker trace similar to that shown in Figure 9-9.

NOTE

Always turn power off when plugging special function components in or taking them out.

b. FAMILIARIZATION - GENERAL

Manipulate the various controls on the Fast Transigate and observe the effects they have on the UM Reflectoscope presentation.

c. FAMILIARIZATION - DETAIL

- (1) With a presentation on the UM Reflectoscope similar to that shown in Figure 9-9 move the pointer on the SYNC control from MAIN PULSE to FIRST ECHO (switch on Time Control unit to I.F.) and observe the effect on the traces. Leave the pointer on FIRST ECHO position. The video and the marker trace are now being synchronized by the first echo (presumably the entrant signal).

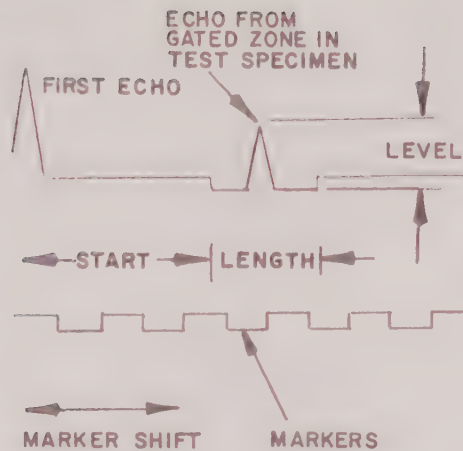


Figure 9-9

UM Reflectoscope Presentation with Fast Transigate On

- (2) Go next to the GATE controls on the Transigate. Move the START pointer and observe that the gate image is moved across the screen in jumps, and that it will disappear to the right if the sweep circuits on the UM Reflectoscope are not readjusted. Next adjust the vernier on the START control and note that it will position the gate image continuously between the steps created by the pointer. Thus any "zone" in the test specimen after the first echo (from the entrant face) can be set up for examination.
- (3) Next adjust the pointer on the LENGTH control and observe that the width of the gate image (and therefore the width of the "zone" in the specimen subjected to examination) changes in jump steps. Then adjust the vernier on the LENGTH control and observe that it will continuously adjust the gate image width between the steps created by the pointer.
- (4) With the sync control on FIRST ECHO and UM SWEEP DELAY on IF sync, it should be possible to achieve a presentation similar to that shown in Figure 9-9.
- (5) Next manipulate the GAIN control on the Pulser Receiver to vary the amplitude of the echo in the gate and at the same time adjust the vernier LEVEL control on the Fast Transigate and observe that the RESET light and buzzer (if the AUDIO switch in ON) can be activated at various predetermined levels of echo signal. Also move the pointer to + and - AUTO positions and note that in the + position a decrease in signal achieves the same

effect; also that the alarms reset automatically. The + and - MANUAL positions have the same effect except that the alarms have to be reset by pushing the RESET light.

- (6) If a Type S Recording Amplifier or a Type R Relay Chassis is being used, consult their operating instructions and observe that they react properly at the same time that the alarms are actuated.

d. TESTING

The gate should be set up according to the above using a test specimen (a "standard") similar to those for which continuous monitoring is desired. As the specimens are passed by the search unit all will be monitored in respect to the same zone and appropriate alarm or recording devices will be actuated in instances where deviations exist.

PRINCIPLES OF OPERATION

1. GENERAL

Figure 9-10 is a block diagram of the Fast Transigate unit. The ECHO GATE receives a trigger from the Time Control Unit coincident with the main pulse or from the INTERFACE SYNC board coincident with the first echo depending upon the position of the SYNC control on the front panel. This trigger actuates the gate multivibrators which produce a square wave (start and width controlled by START and LENGTH controls on front panel). This wave produces the gate image on the CRT and at the same time gates the video amplifier on the ECHO GATE which permits any video (echo pulses) which may be present from the specimen coincident with the gate to be passed to the RECORDER board.

The RECORDER board accepts the gated video and produces a DC level proportional to the amplitude of the largest signal in the gate. This DC is sent out via the R or S chassis to drive penmotor type recorders. It is also used to trigger a binary circuit (under control of the LEVEL adjustment) on the RECORDER board. The on-off signal so produced is used to drive ALFAX type recorders and is also sent to the ALARM board to actuate the audio and visual alarm circuitry.

The ALARM board accepts the alarm signals from the RECORDER board (through front panel controls) and functions as an "automatic reset" oneshot or a "manual" flip-flop and drives the internal light and buzzer alarms.

The INTERFACE SYNC board accepts video from the UM Reflectoscope and after delay which blanks out the "main bang" permits the first echo (from entrant acc) to generate a trigger which is sent to the ECHO GATE to synchronize the gating circuitry.

The front and rear panel assembly contains the various external controls and jacks and connectors for interconnecting the Transigate and for providing output alarm and print signals.

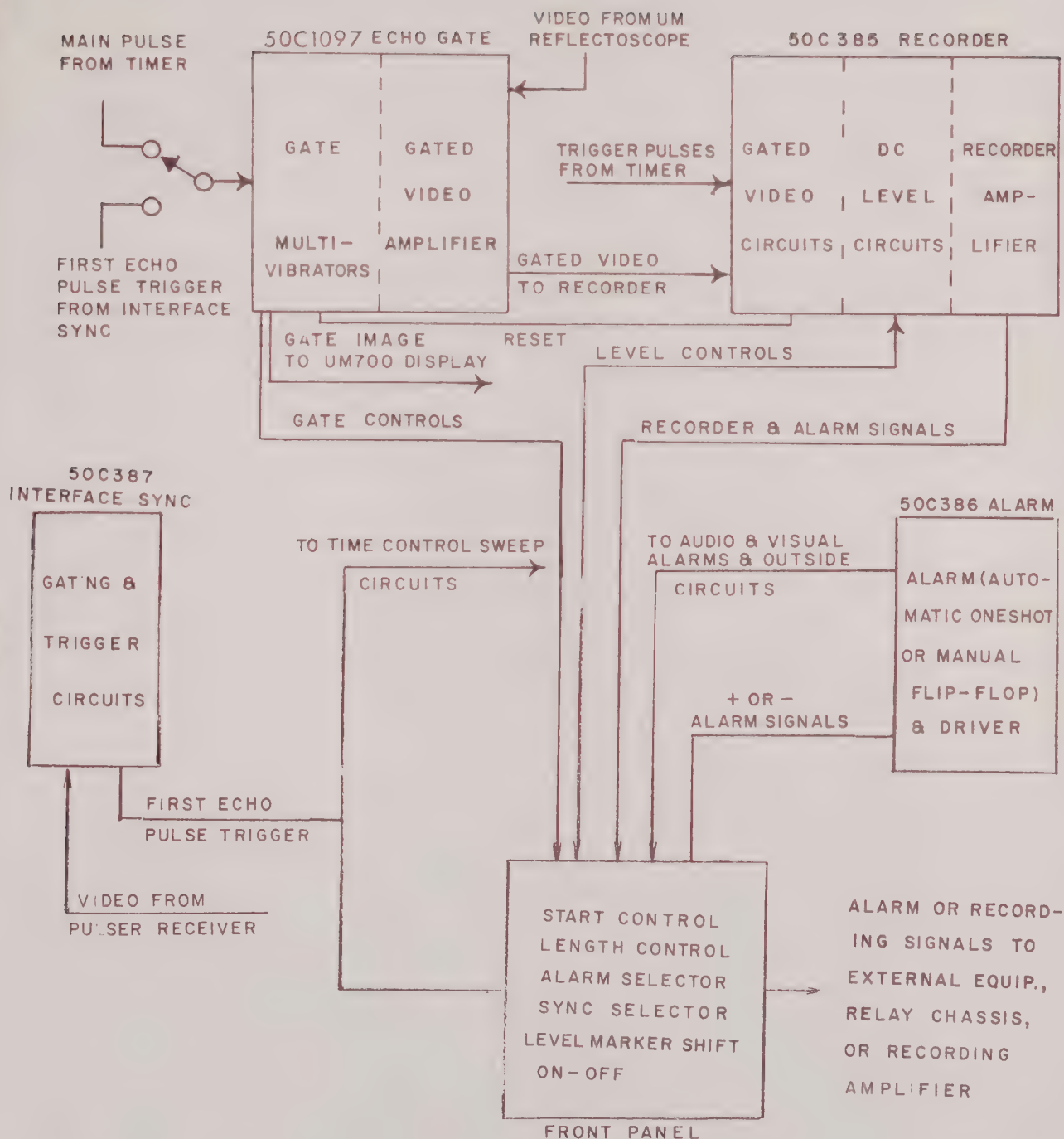


Figure 9-10
Block Diagram of Fast Transigate Unit

In the following detailed discussion of the circuitry, reference should be made to the overall schematic of the Fast Transigate unit.

2. ECHO GATE 50C1097 (See Figure 9-11)

The Sync #2 square wave generated by the timer in the UM Reflectoscope is connected to pin 4, J201 via pin 13, J101 and is differentiated and clamped at C201, R217, and CR207. Q206 affords a low impedance trigger source for following circuits. When the front panel SYNC switch is set at MAIN PULSE, this trigger source is connected to pin 6, J201.

Q205 and Q201 comprise a monostable or oneshot multivibrator. The positive trigger pulse is amplified and inverted regeneratively by Q205. The resulting negative trigger couples the charge across C105, C106, C107, or C108 (depending on switch position). The output square pulse is differentiated by C203 and R210, and coupled into the "length oneshot" monostable multivibrator, Q207 and Q202. A negative going square pulse is coupled through R213 to emitter follower, Q203, which is connected to both the gate display amplifier and the gate circuits. The gate display amplifies and inverts the gate signal through Q210, and provides a low impedance output to the Reflectoscope through emitter follower Q208. Diode R221 provides isolation from other Transigates which might be used simultaneously. The gate waveform is also applied to the base of gating transistor Q209, the negative pulse turning this transistor off during the gate period. Video comes into the gate on pin 19 J201, and appears on the collector of Q209 during the gate period. All signals before and after the gate period are shortened to ground by Q209. The gated video is stretched by capacitors C208 and C209, and emitter followers Q212 and Q211. Amplifier Q204 amplifies and inverts the gated video which appears at pin 18 J201. Amplitude of these signals are set by gain pot R225. Pedestal pot R221 sets the minimum level at which gated video will appear.

3. RECORDER BOARD 50C385 (See Figure 9-12)

Gated video from the ECHO GATE board enters at pin 8, J301. Q301 provides power gain to charge C301 through CR301 to near the video peak value. The gated video through Q301 is negative going and changes the voltage level at pin 4 of V301 from a quiescent 12 volts to the negative going peak value of the incoming gated video. The reverse slope of the video is disconnected from C301 by diode CR301. This leaves the peak voltage charge on C301 which is also present at pin 4, V301. By cathode follower, (V301) this new voltage level is transferred to pin 8, V301. There is also the same quiescent 12 volt level at pin 4, V302. The new level at pin 8, V301 is now transferred to pin 4, V302 through CR303 diode. C308 is now at this new level. This all occurs during the first half cycle of the timer sync wave form.

At the half cycle interval of the sync wave form, a trigger pulse is derived from pin 10, J301. Q306 affords power gain to drive reset amplifier Q302. The short pulse, positive going, recharges C301 back to its initial -12 volt quiescent level via CR302. This level is again transferred to pin 8, V301. This time, however, CR303 is reverse biased and allows the original charge to be kept on C308. This capacitor now remembers the peak value of the last gated video pulse because of the very long time constant involved. The next main bang now occurs. If the new gated video coming from pin 8, J301 is greater in amplitude than the charge on C308, then both C301 and C308 will reach this new level. If the new level coming from pin 8 is of a lower amplitude, then only C301 is charged to its new level without affecting C308.

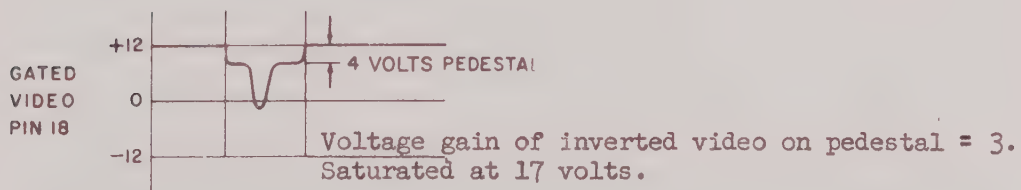
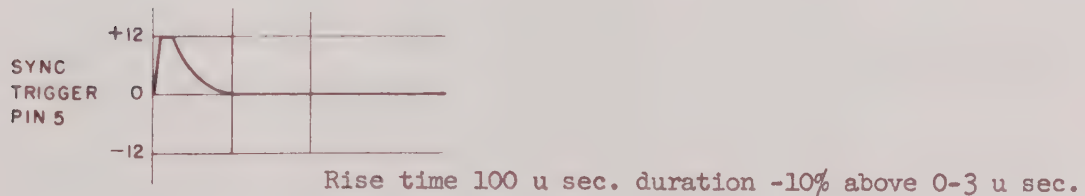
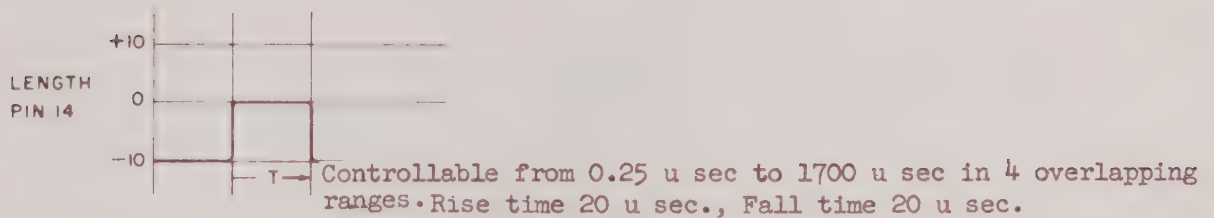
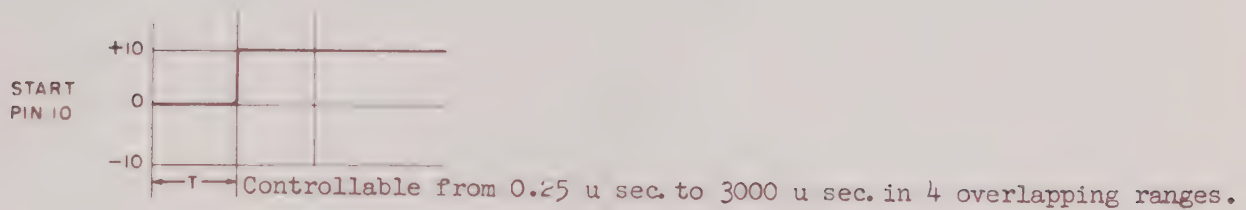
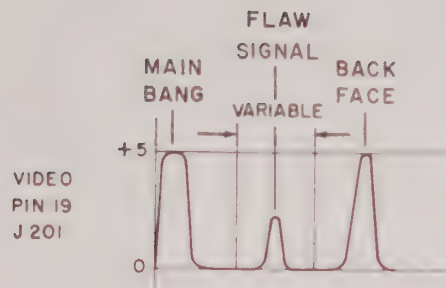


Figure 9-11'
Echo Gate Waveforms

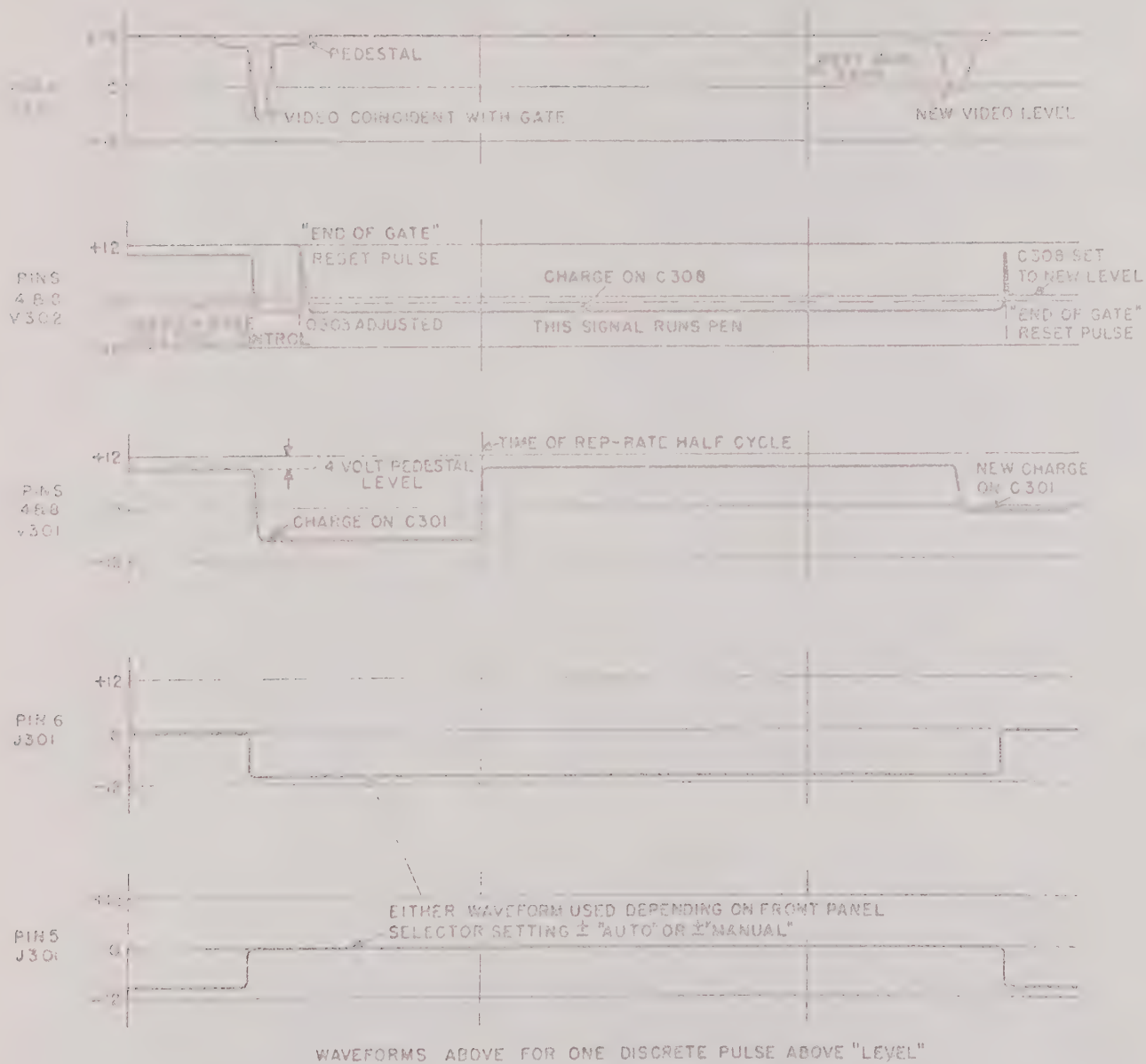


Figure 9-12
Recorder Waveforms

At the end of the gate a reset trigger pulse is derived from pin 19, J301, and is shaped and fed to reset amplifier Q307. The positive going pulse at the collector of Q307 connects CR304 and recharges C308 to +12 volt level but, because this is a short pulse, CR304 quickly disconnects while CR303 immediately connects and puts the "new peak" video level on C308. Thus the voltage level at pin 8, V302 varies in step intervals with its level proportional and approximately equal to the peak value of the gated video. If the gated video level is constant, the voltage level at pin 8, V302 is constant. If only one video pulse should enter, then a square pulse proportional to the height of the video pulse and equal to the time between the gated video and the end of the next gate will be presented.

CR102 on the LEVEL control maintains a constant DC level across R110 which varies the amount of reverse bias on Q303. Any signal in addition to this reverse bias must be great enough to make Q303 conduct. Proper rotation of the control will achieve this as will a changing voltage caused by incoming gated video at pin 8, J301. When Q303 does conduct, it affords power gain to make Q304, Q305 ("recorder amplifier") trip. Q304 and Q305 can only be in one of two conditions. When the collector of Q304 is at -10 volts, the collector of Q305 must be at ground potential and vice versa, so that when a gated video signal is great enough to overcome the controllable reverse bias on Q303, Q303 conducts making Q304-Q305 trip. As soon as the video disappears from the gate, they will go back to their original state.

By choosing the proper point (pin 6 or pin 5, J301), a negative signal is derived for either rising or falling gated video. This signal voltage will be present only when incoming gated video is greater than the setting of the LEVEL control bias.

4. INTERFACE OR FIRST ECHO SYNC 50C387 (See Figure 9-13)

Q506 and Q507 form the major components of a transistor oneshot multivibrator. The collector of Q507 is normally near ground potential. This allows Q501 to act as an amplifier inverter for video signals incoming from pin 4, J501. Q501 is in this condition only between the end of delay of the "gate oneshot" and the advent of the next video pulse.

A concurrent trigger, positive going, from pin 5, J501 occurs during the "main bang" time and sets the "gate oneshot" Q506-Q507 into its quasi-stable state. The duration of this condition depends on the time constant of R504 times C501. While the oneshot is in its temporary state, the collector Q507 is at approximately -12 volts. This cuts off Q501 so that any incoming video will not be passed to Q502-Q503 binary. During the delay time being generated by Q506-Q507 "gate oneshot" flip-flop Q502-Q503 was set into one state by the same pulse that initiated the "gate oneshot".

After the delay has run its course in the "gate oneshot", Q501 is then turned on so that it may amplify incoming video. The first video pulse that enters after the delay is amplified in Q501 which in turn resets the "IF flip-flop" Q502-Q503. At the advent of this reset time, a pulse is sent through a shaper network and into trigger amplifier Q508 which in turn sends the pulse to the sweep generator. Any other video that may follow will no longer have any effect on the "IF flip-flop" so that no further trigger pulses to the sweep generator will come from this source until after the next "main bang" and delay. The start of the sweep will be coincident with the first echo after the "main bang" which presumably is an interface signal.

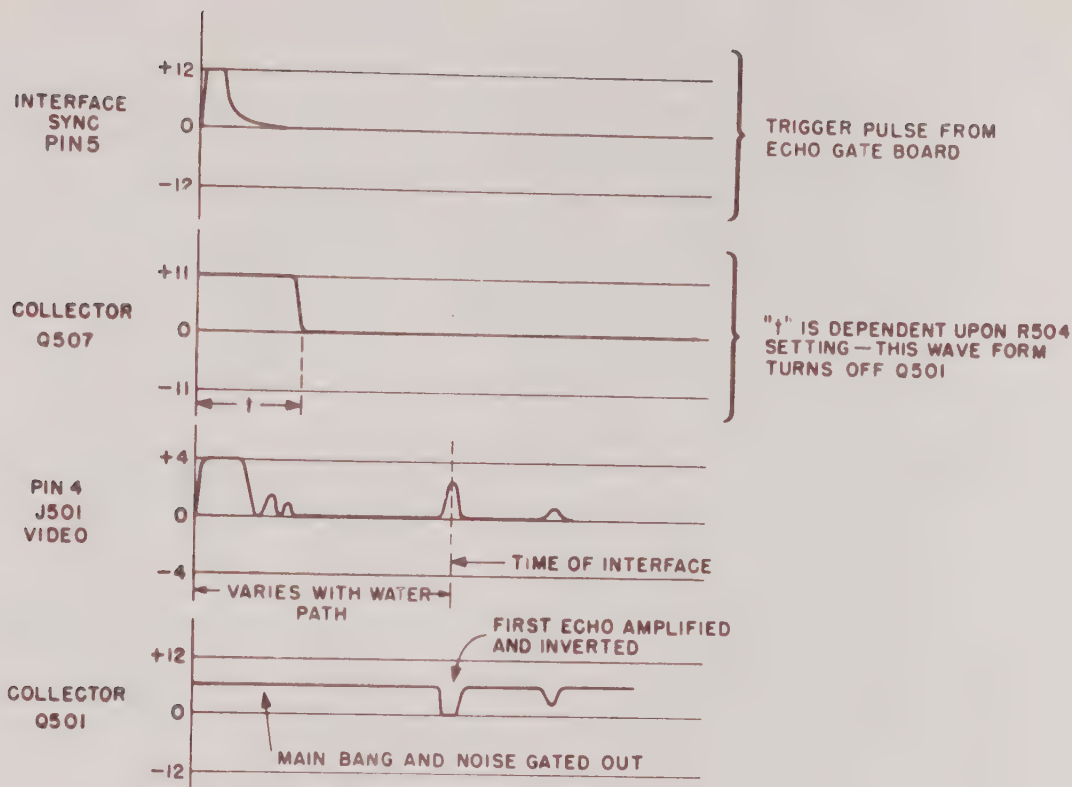


Figure 9-13
Interface Sync Waveforms

5. ALARM BOARD 50C386 (See figure 9-13)

When S103 (ALARM switch on front panel) is in either plus (+) or minus (-) AUTO position, Q401-Q402 are connected as a transistor oneshot multivibrator with a quasi-stable duration of approximately 152 milliseconds. With S103 in AUTO position and no video in the gate on the CRT above the LEVEL control setting, there will be a negative 10 volts present at pin 7, J401. If this is a short negative pulse (one single video pip in a long time) CR404 will connect this short pulse (which is always at least one rep-rate cycle long) to the oneshot which in turn will generate a 150 millisecond output through Q403 "EF driver".

If the video in the gate is continual, CR404 will remain connected because there is a continuous negative signal at pin 7, J401. Even though the oneshot time constants have run down, the multivibrator will not reset as long as pin 7 is negative.

When S103 is in + MANUAL RESET position, Q401-Q402 becomes a flip-flop whose "armed" or "set" condition is Q401 "off", Q402 "on". When pin 7 turns negative CR404 connects and turns Q401 "on" and Q402 "off". This condition will remain regardless of what happens at pin 7; this is a continuous condition and can only be reset by closing S105 contacts manually.

The output from the ALARM board turns on transistor Q101 on the rear panel which actuates lamp DS103 and the buzzer if the AUDIO SWITCH, S106, is on. A signal is also present at pin 4, J401, for external purposes.

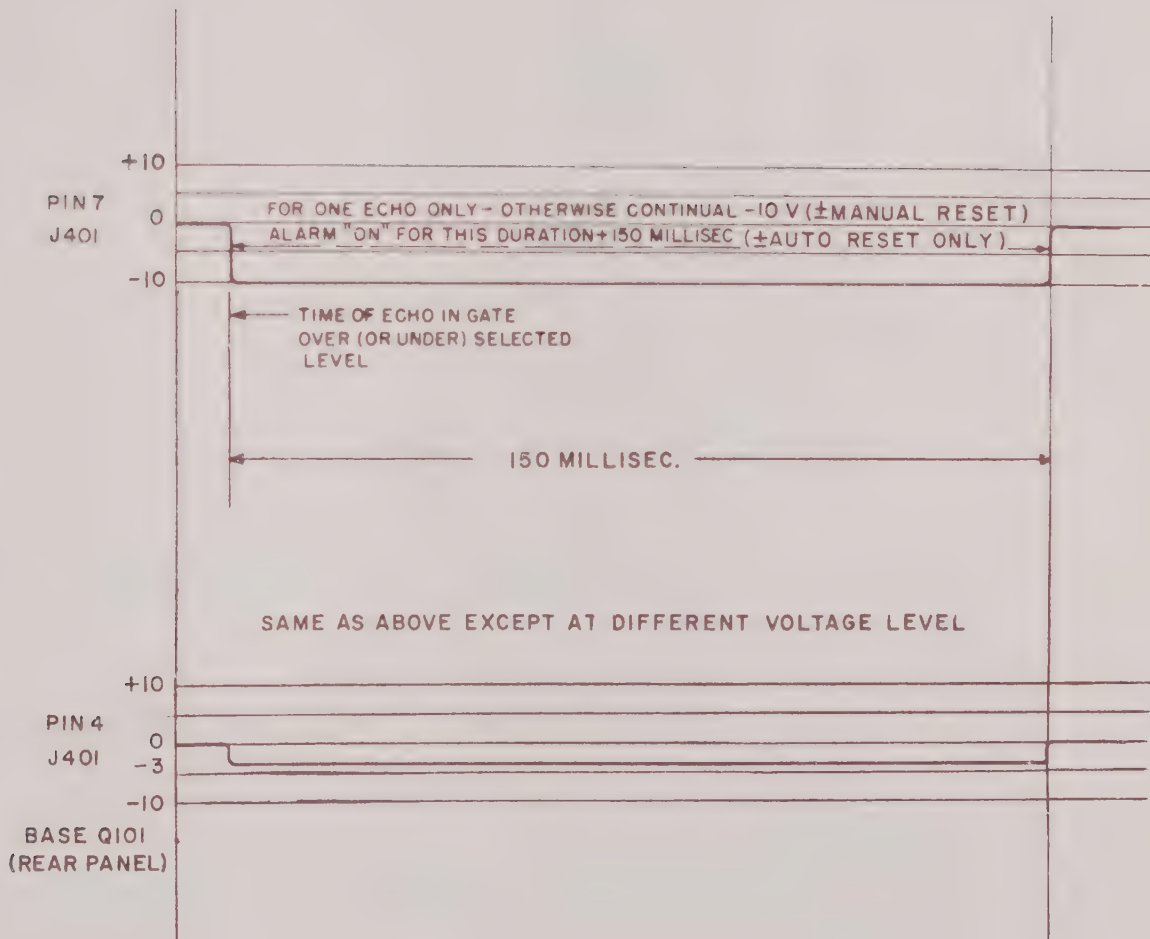


Figure 9-14
Alarm Board Waveforms

MAINTENANCE

WARNING

NEVER CONNECT OR DISCONNECT
TRANSISTORIZED PLUG-IN UNITS
OR P.C. BOARDS WHEN UM
REFLECTOSCOPE IS "ON".

1. GENERAL

a. TEST AND ASSOCIATED EQUIPMENT

The following test and associated equipment is required for checking the Fast Transigate:

- (1) Servistension style 50C495.
- (2) Tektronix 531 or equivalent, recently calibrated.
- (3) Simpson Model 260, recently calibrated.

PERSONAL SAFETY WARNING

Lethal voltages are present - always turn instrument OFF when changing components. Always keep one hand in clear when making temporary connections (connecting test leads, etc.).

2. TRANSIGATE 50C753 CHASSIS INSPECTION AND MEASUREMENT

- a. Inspect chassis for loose or broken connections, loose components, signs or overheating, etc.
- b. Rotate all front panel controls full counter-clockwise.
- c. Turn AUDIO switch off.
- d. Turn GATE switch off.
- e. Use Servistension and turn Fast Transigate unit on. At printed circuit board connectors measure voltages listed in Chart 1 using Simpson 260 or equivalent.

CHART 1

FAST TRANSIGATE VOLTAGE MEASUREMENTS

1	+12VDC	1	+12VDC	1	1	+12VDC	1	+11VDC
2	-12VDC	2	-12VDC	2	2	-12VDC	2	-12VDC
3	0.0V	3	0.0		3	0.0	3	0.0
4	+5.4V	4	+1.3V		4	-0.2V	4	-11.5V
5	.2V	5	+0.1V		5	+3.7V	5	
6	-10V	6	0.0		6	+0.6V	6	0.0
7		7	+8.2V		7	0.0	7	- 2.2V
8		8	+0.95V		8	+3.7V	8	+ .2V
9		9	0.0		9		9	
10		10	-3.4V		10	+12	10	+ 1.3V
11		11	0.0		11		11	+ 150V
12		12	-12V		12		12	
13		13	-12V		13		13	
14		14	0.0		14		14	0.0
15		15	-3.9V		15		15	0.0
16		16	0.0		16		16	+10.7V
17		17	-107V		17		17	-107V
18		18	+12V		18		18	- 1.8V
19		19	+0.85V		19		19	-11.8V
20		20	0.0				20	

J501
IF
Board

J201
Echo
Gate

J401
Alarm

J301
Record

ALL CONTROLS CCW
ALARM ON
GATE OFF
AUDIO OFF

ALL VOLTAGES DC TO GROUND
EXCEPT PIN 14 J301

FAST TRANSIGATE UNIT

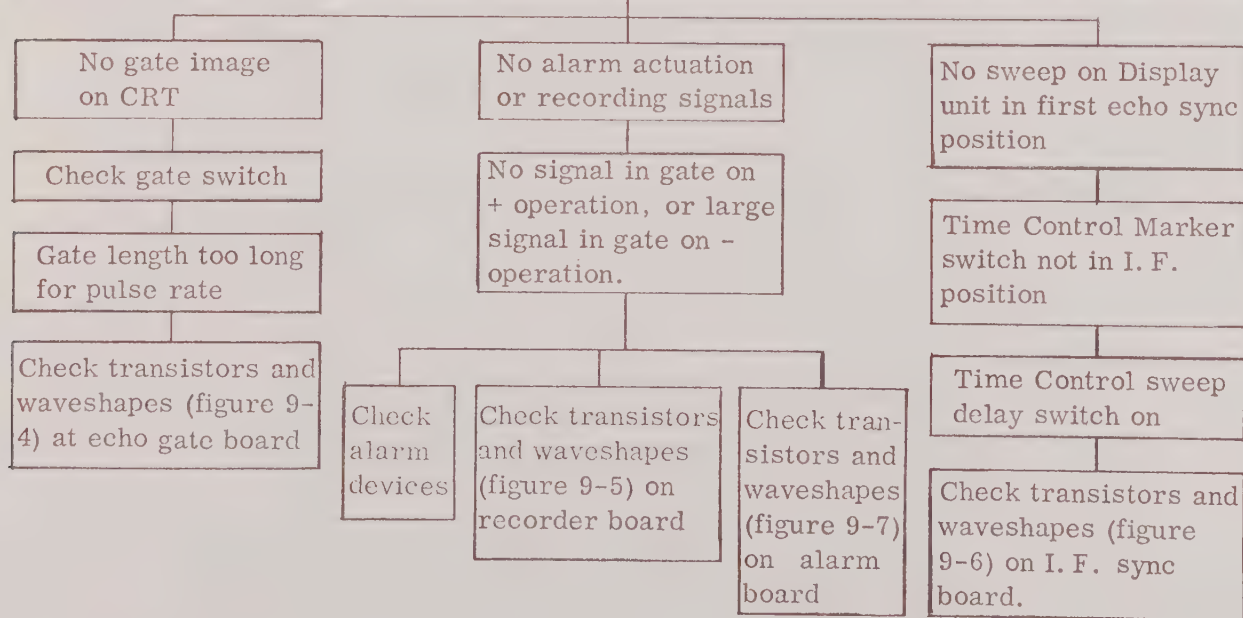
<u>CONTROL</u>	<u>SETTINGS</u>	<u>CONTROL</u>	<u>SETTINGS</u>
SYNC	MAIN PULSE OR FIRST ECHO	AUDIO SWITCH	ON
MARKER SHIFT	MID RANGE	GATE SWITCH	ON
ALARM		START POINTER	1
LEVEL	MID RANGE	START VERNIER	MID RANGE
SELECTOR	+ AUTO	LENGTH POINTER	1
		LENGTH VERNIER	MID RANGE

TRANSIGATE UNIT IRREGULAR OR INOPERATIVE

Check that unit is properly in place, UM Reflectoscope is operating properly, cables are connected and firmly seated, controls on Transigate are properly set.

Remove Transigate and visually inspect for loose or missing transistors, poor connections on wires or components, burned components, or other obvious trouble.

Check voltage according to Chart 1



PARTS LIST

FAST TRANSIGATE UNIT - STYLE 50C753

Reference Schematic 50E573

Schematic Symbol Number	Sperry Part Number	Description
C101	DQG002A04	Capacitor .1 uf
C102	DQL001A22	Capacitor 250 uf
C103	DQL001A22	Capacitor 250 uf
C104	DQG002A04	Capacitor .1 uf
C105	Aerovox	Capacitor .68 uf 50 vdc
C106	Aerovox	Capacitor .068 uf 50 vdc
C107	Arco	Capacitor 6800 uuf 100 vdc
C108	Arco	Capacitor 680 pf 300v
C109	Arco	Capacitor .25 uf 100 vdc
C110	Arco	Capacitor .015 uf 200 vdc
C111	Arco	Capacitor .3000 pf 300v
C112	Arco	Capacitor 300pf 500v
C113	Centralab	Capacitor .1 uf DA-104
C114	Centralab	Capacitor .1 uf DA-104
CR101	1N2525	Diode
CR102	1N1315A	Diode
CR103	1N90	Diode
R101	50A3164	Potentiometer 10K
R102	DPA004B23	Resistor 910 K 1/2 W 5%
R103	Part of 50B804	Potentiometer 500K
R104	DPA006D15	Resistor 39K 1 W 5%
R105	Same as R102	
R106	50A3163	
R107	DPA004C18	Resistor 5. 1K 1/2 W 5%
R108	DPA004D02	Resistor 11K 5%
R109	Part of 50B803	Potentiometer 0.5 Meg
R110	Part of 50B805	Potentiometer 10K
R111	DPA004E10	Resistor 240K 1/2 W
R112	Not Used	
R113	DPA004D20	Resistor 62K 1/2W
R114	DPA005E07	Resistor 330K 1/2W
Q101	2N399	Transistor
DS101	Line Electric	Buzzer Series MD 6 vac
DS102	NE2	Lamp Neon
DS103	330	Lamp
S101	50A3164	Switch
S102	50A3163	
S103	Part of 50B805	Switch Rotary
S104	Part of 50B803	Switch Rotary
S105	50A2557	Switchlite
S106		Switch Slide SPST
S107		Switch Slide DPST
J101	CQC017P01	Plug

Schematic Symbol Number

Sperry Part Number

Description

J201
J301
J401
J501
L101
L102
E101

Elco
Elco
Elco
Elco
J. W. Miller
J. W. Miller
C. T. C.
Southco
Bendix
OOA078

Connector PCU420B
Connector PCU420B
Connector PCU420B
Connector PCU420B
RF Choke 4626
RF Choke 4626
Terminal
Fastener 48-10-102-10
Transistor Socket 210-6500
Nameplate

50C1097 ECHO GATE P. C. BOARD

C201
C202
C203
C204
C205
C206
C207
C208
C209
C210
C211
C212
CR201
CR202
CR203
CR204
CR205
CR206
CR207
CR208
CR209
CR210
CR211
CR212
CR213
CR214
CR215
CR216
CR217
CR218
CR219
CR220
CR221
CR222
R223
R224
R225
R226
R227
R228
R229

DQB005B44
CM-15-E-101-5
Same as C202
DQB005B18
DQB005B42
not used
DQB005B04
DQB005B11
DQB005B34
Same as C202
Sprague
DQB005B21
1N914
1N995
Same as CR202
Same as CR201
Same as CR202
1N313
1N482
not used
not used
Same as CR202
Same as CR202
Same as CR206
Same as CR202
Same as CR211
Not used
Same as CR201
Same as CR202
Same as CR206
not used
Same as CR201
Same as CR201
not used
not used
DPA004C05
Same as R201
not used
Same as R212

Capacitor 470 uuf 500v
Capacitor 100 uuf
Capacitor 47 uuf 500v
Capacitor 390 uuf 500v
Capacitor 5uuf 500v
Capacitor 24 uuf 500v
Capacitor 200 uuf 500v
200
Capacitor .22 uuf 25v 5C9
Capacitor 56pf Arco 50Dcu
Diode Hughes
Diode Hughes
Diode
Diode

Resistor 1.5 K 1/2 W $\pm$ 5%

Schematic Symbol Number

Sperry Part Number

Description

R230	Same as R201	
R231	DPA004B13	Resistor 330 ohms 1/2 W $\pm 5\%$
R232	Same as R218	
R234	not used	
R235	DPA004C17	Resistor 4.7 K 1/2 W $\pm 5\%$
R236	Same as R236	
R237	Same as R201	
R238	DPA004D02	Resistor 10K 1/2 W $\pm 5\%$
R239	Same as R212	
R240	DPA004C24	Resistor 9.1K 1/2 W $\pm 5\%$
R241	DPA004E01	Resistor .00K 1/2 W $\pm 5\%$
R242	Same as R231	
R243	Same as R218	
R201	DPA004C01	Resistor 1K 1/2W $\pm 5\%$
R202	DPA004C09	Resistor 2.2K 1/2W $\pm 5\%$
R203	not used	
R204	DPA004C23	Resistor 8.2K 1/2W $\pm 5\%$
R205	DPA004C11	Resistor 2.7K 1/2W $\pm 5\%$
R206	Same as R204	
R207	Same as R201	
R208	Same as R205	
R209	not used	
R210	DPA004C07	Resistor 1.8K 1/2W $\pm 5\%$
R211	DPA004B19	Resistor 560 ohms 1/2W $\pm 5\%$
R212	DPA004B01	Resistor 100 ohms 1/2W $\pm 5\%$
R213	Same as R201	
R214	Same as R202	
R215	DPA007B21	Resistor 680 ohms 1/2W $\pm 5\%$
R216	Same as R215	
R217	DPA004D05	Resistor 15K 1/2W $\pm 5\%$
R218	DPA004C08	Resistor 2K 1/2W $\pm 5\%$
R219	not used	
R220	DPA004D17	Resistor 47K 1/2W $\pm 5\%$
R221	Bourns	Potentiometer 5K 275-1-502
R222	not used	
Q201	2N797	Transistor
Q202	2N964	Transistor
Q203	Same as Q202	Transistor
Q204	2N338	Transistor
Q205	Same as Q201	Transistor
Q206	2N385	Transistor
Q207	Same as Q202	Transistor
Q208	2N1308	Transistor
Q209	Same as Q201	Transistor
Q210	2N706A	Transistor
Q211	Same as Q210	
Q212	Same as Q208	

50C385 RECORDER P. C. BOARD

C301
C302Avco
not usedvdc
Capacitor .001 uf 600 (OP-1-102

Schematic Symbol Number

Sperry Part Number

Description

C303	Not used	
C304	DQB005B33	Capacitor 180 uuf 500v
C305	DQB005B39	Capacitor 300 uuf 500v
C306	Erie	Capacitor 510 uuf ED-510
C307	Not used	
C308	Avco	Capacitor .004 uf 600 vdc 6DP-1-402
CR301	1N485	Diode
CR302	Same as CR301	
CR303	Same as CR301	
R301	DPA005B06	Resistor 270 ohms 1/2W $\pm 5\%$
R302	DPA008C19	Resistor 5.6K 1/2W
R303	DPA004D02	Resistor 11K 1/2W $\pm 5\%$
R304	DPA004D05	Resistor 15K 1/2W $\pm 5\%$
R305	DPA004B18	Resistor 510 ohms 1/2W $\pm 5\%$
R306	DPA004C24	Resistor 9.1K 1/2W $\pm 5\%$
R307	Same as R305	
R308	DPA004D01	Resistor 10K 1/2W $\pm 5\%$
R309	DPA004D19	Resistor 56K 1/2W $\pm 5\%$
R310	DPA004D10	Resistor 24K 1/2W $\pm 5\%$
R311	DPA004B24	Resistor 910 ohms 1/2W $\pm 5\%$
R312	DPA004D17	Resistor 47K 1/2W $\pm 5\%$
R313	Same as R312	
R314	Same as R312	
R315	DPA005C10	Resistor 5.6K 1/2W $\pm 5\%$
R316	Same as R304	
R317	DPA004C07	Resistor 1.8K 1/2W $\pm 5\%$
R318	DPA004C08	Resistor 2K 1/2W $\pm 5\%$
R319	DPA004E22	Resistor 750K 1/2W $\pm 5\%$
R320	Same as R308	
R321	Not used	
R322	DPA004C15	Resistor 3.0 1/2W $\pm 5\%$
R323	Not used	
R324	DPA007D10	Resistor 56K 1/2W $\pm 5\%$
R325	Same as R312	
R326	Same as R308	
R327	DPA004D13	Resistor 33K 1/2W $\pm 5\%$
Q301	2N404	Transistor
Q302	2N404	Transistor
Q303	2N404	Transistor
Q304	2N404	Transistor
Q305	2N404	Transistor
Q306	2N404A	Transistor
Q307	2N404	Transistor
V301	6CW4	Tube
V302	6CW4	Tube
	Elco	Transistor Socket 3303
	Cinch-Jones	Tube Socket 133 65101001
	50B807	Recorder P. C. Board Sub-Ass

Schematic Symbol Number	Sperry Part Number	Description
C401	Cornell-Dubilier	Capacitor 20 uf 25 vdc NL-20-25
C402	DQB005B36	Capacitor 240 uuf 500v
C403	Same as C402	
C404	Sprague	Capacitor .05 uf 50 vdc 55C23
CR401	1N90	Diode
CR402	Same as R401	
CR403	Same as CR401	
CR404	Same as CR401	
R401	DPA004C18	Resistor 5.1K 1/2W +5%
R402	DPA004B13	Resistor 330 ohms 1/2W +5%
R403	DPA004C08	Resistor 2K 1/2W +5%
R404	Same as R401	
R405	Same as R403	
R406	Same as R403	
R407	DPA004B18	Resistor 510 ohms 1/2W +5%
R408	Same as R407	
R409	Same as R407	
R410	DPA004D01	Resistor 10K 1/2W +5%
R411	Same as R410	
R412	DPA004B08	Resistor 200 ohms 1/2W + 5%
R413	DPA004B05	Resistor 150 ohms 1/2W +5%
Q401	2N404	Transistor
Q402	Same as Q401	
Q403	Same as Q401	

50C387 INTERFACE SYNC P. C. BOARD

C501	Avco	Capacitor .002 uf 600 vdc 6DP-1-202
C502	DQB005B32	Capacitor 106 uuf 500v
C503	Centralab	Capacitor .02 uf 30 vdc DA-203
C504	Not used	
C505	Not used	
C506	DQB005B39	Capacitor 300 uuf 300v
C507	Same as C506	
C508	Not used	
C509	Not used	
C510	Erie	Capacitor .01 uf 100 vdc ET8805
C511	DQB005B40	Capacitor 330 uuf 300v
C512	Not used	
C513	Not used	
C514	Not used	
C515	DQB005B33	Capacitor 180 uuf 500v
CR501	1N90	Diode
CR502	Not used	
CR503	Not used	
CR504	Not used	
CR505	Same as CR501	
R501	DPA004C13	Resistor 3.3K 1/2W +5%
R502	DPA004C01	Resistor 1K 1/2W +5%
R503	DPA004C18	Resistor 5.1K 1/2W +5%
R504	Bourns	Potentiometer 50K 276-1-503
R505	Not Used	

Schematic Symbol Number

Sperry Part Number

Description

R506

DPA004D14

Resistor 30K 1/2W $\pm 5\%$

R507

DPA004B21

Resistor 680 ohms 1/2W $\pm 5\%$

R508

Same as R506

R509

Not used

R510

Not used

R511

Not used

R512

DPA004D03

Resistor 12K 1/2W $\pm 5\%$

R513

DPA004C07

Resistor 1.8K 1/2W $\pm 5\%$

R514

DPA004D05

Resistor 15K 1/2W $\pm 5\%$

R515

Same as R514

R516

Not used

R517

Not used

R518

DPA004D18

Resistor 51K 1/2W $\pm 5\%$

R519

DPA004E03

Resistor 120K 1/2W $\pm 5\%$

R520

DPA004C16

Resistor 4.3K 1/2W $\pm 5\%$

R521

Same as R503

R522

Same as R513

Q501

2N565

Transistor

Q502

2N404

Transistor

Q503

Same as Q502

Q504

Not used

Q505

Not used

Q506

Same as Q501

Q507

Same as Q501

SECTION IX

TRANSIGATE - STYLE 50E550

DESCRIPTION

1. GENERAL

The Transigate has been designed to plug into the Special Function Cabinet for operation with Type UM Reflectoscopes. Used in combination with other Special Function components or external monitoring equipment, the Transigate provides flexibility in establishing ultrasonic inspection systems for semi-automatic or automatic detection of flaws in materials at production speeds. This is accomplished by setting up specific, controllable gated areas or zones within a test piece. Signals appearing within these gates may be monitored automatically to operate visual and/or aural alarms.

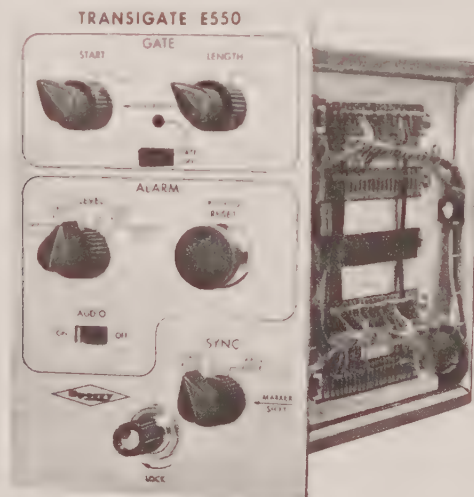


Figure 9-1
Front View of Transigate

The Transigate incorporates a single channel gate (adjustable in start and length) and a discriminator level set. An interface sync control may be used to lock the gate start position (and sweep circuits if timer marker switch is set to I. F. position) on the first signal received after the initial pulse (first echo signal - usually the entrant surface of the test piece). Using immersed testing techniques, this assures that any variation of water path distance

(distance between the search unit and the surface of the test piece) will not affect the position of signals, markers, or gates appearing along the sweep. Visual and aural alarms are included in the form of a panel light and an internal buzzer. Output of recording and alarm information is also provided for operation of other Special Function components or for external control and recording devices.

The Transigate may be disabled by a simple GATE OFF switch without disturbing other set-up conditions in the Special Function Cabinet or in the UM Reflectoscope. Additional Transigates may be added to meet the requirements of tests where more than one area of a test piece is to be inspected in one pass or where response to more than one level within a single area is desired.

The Transigate consists of the following major components:

a. ECHO GATE 50C384

Printed circuit board containing circuitry for generation of the square wave used to establish the "gate" or "zone" and the gated video amplifier which passes signals from the UM Reflectoscope through the "zone" to the Recorder Board. Also sends gate image signal to UM Reflectoscope Display (figure 9-2).

b. RECORDER BOARD 50C385

Printed circuit board containing circuitry for accepting gated video from ECHO GATE, establishing DC level proportional to video signal amplitude, and furnishing amplitude and on-off signals to alarm circuitry, ALFAX Recorders, and penmotor type recorders.

c. ALARM BOARD 50C386

Printed circuit board containing circuitry for accepting alarm signals from RECORDER, functioning as automatic or manual reset device, and driving aural and visual alarm devices.

d. INTERFACE OR FIRST ECHO SYNC 50C387

Printed circuit board containing circuitry for gating video to eliminate main bang, generating trigger in response to first echo or interface signal which is sent to ECHO GATE circuitry, and providing marker

sweep sync to allow marker shift in relation to main sweep on UM Reflectoscope (with Time Control Unit MARKER control in IF position).

e. FRONT AND REAR PANEL ASSEMBLY

Structural portion of Transigate which accepts individual circuit boards: containing audio and visual alarms and external controls on front panel and connectors for interconnecting Transigate in Special Function Cabinet and with UM Reflectoscope on rear panel.

2. MECHANICAL SPECIFICATIONS

The Transigate plugs into the Special Function Cabinet and is easily disconnected for servicing or interchange. The following front panel controls are provided:

a. GATE CONTROLS:

START (pointer)

START (vernier)

LENGTH (pointer)

LENGTH (vernier)

GATE OFF and Indicator Lamp

b. ALARM CONTROLS:

LEVEL (vernier)

+ AUTO RESET (pointer)

- AUTO RESET (pointer)

+ MANUAL RESET (pointer)

- MANUAL RESET (pointer)

RESET LIGHT SWITCH

AUDIO ON-OFF

c. SYNC CONTROLS:

MAIN PULSE (pointer)

FIRST ECHO (pointer)

MARKER SHIFT (vernier)

3. ELECTRICAL SPECIFICATIONS

All power requirements are obtained from the UM Reflectoscope Display Unit.

4. GATES

Gate Start - 2 u sec. to 3000 u sec. (1/4 in. to 30 ft. in steel).

Gate Length - 2 u sec. to 3000 u sec. (1/4 in. to 30 ft. in steel).

5. RECORDING SIGNALS

- a. To operate strip-chart recorders on any signal appearing in the gated area, a DC recording signal (+12 to 0 v) is provided that is proportional to the largest unsaturated signal in the gate. This signal has instantaneous response. Duration is equal to one repetition-rate cycle plus the time to the end of the next gate - or as long as signals remain in the gate.
- b. For purposes of selective alarming on signals that either exceed or fall below a set level (positive or negative response), the Transigate provides a DC on-off signal (0 and -10 vdc). This can be used for facsimile recorders or for relay and solenoid operation.

6. RANGE OF LEVEL CONTROL

Range of the alarm LEVEL control is 1/8 in. to 3 in. (full scale).

7. OPERATING TEMPERATURE RANGE

Stable and reliable operation is provided over the range 0°F. to 120°F.

OPERATION

1. FUNCTION OF CONTROLS (Figure 9-1)

a. GATE CONTROLS (COMBINATION VERNIER AND POINTER)

(1) START (pointer)

Provides coarse positioning of the gate start (figure 9-2).

(2) START (vernier)

Permits fine, continuous control of the gate start position between the coarse ranges noted above.

(3) LENGTH (pointer)

A coarse control which sets the width (or length) of the gate (figure 9-2).

(4) LENGTH (vernier)

Provides a fine continuous control of gate width between the coarse ranges noted above.

(5) GATE OFF

Permits the disabling of gate without disturbing any of the variable controls. When the lamp is OFF, the gate is ON.

b. ALARM CONTROLS (COMBINATION VERNIER AND POINTER)

(1) LEVEL (vernier)

Establishes the signal level (on the UM Reflectoscope display) at which alarms, relays or on-off printing will be activated or initiated (figure 9-2).

(2) + AUTO RESET (pointer)

Sets up systems to alarm when any displayed signal within the gate (figure 9-2) increases above the level set by the LEVEL control. The alarm buzzer will sound and the panel light will remain on for a minimum of 0.1 sec., or as long as a signal above the level set remains in the gated area. Alarm circuits reset automatically when the signal decreases in amplitude below the alarm level, or is no longer in the gate.

(3) - AUTO RESET (pointer)

With the control in this position, the system is set to alarm when the signal within the gated area falls below the level set by the LEVEL control. Alarms will remain activated for a minimum of 0.1 sec., or as long as the signal remains below the level set in the gate. Alarm circuits reset automatically when the signal increases in amplitude above the alarm level.

(4) + MANUAL RESET (pointer)

This control position sets the system to alarm on any signal appearing in the gate having an amplitude greater than that set by the LEVEL control. The alarms (light and buzzer) will remain activated until reset manually by pressing the RESET light switch.

(5) - MANUAL RESET (pointer)

Sets the system to alarm when the signal appearing within the gated area falls below the level that has been pre-set by the LEVEL control. A single video pulse that drops below the level set will activate the alarms (buzzer and light) which must then be reset manually by pressing the RESET light switch.

(6) RESET LIGHT SWITCH

The RESET light is activated by an alarm signal and remains on until reset automatically or manually as described above.

(7) AUDIO ON-OFF

This switch controls the buzzer alarm. If no audible alarm is wanted, this switch is set to OFF.

NOTE

In all of the above conditions (alarm, level and reset), an on-off type printing signal is available. The minimum duration of this signal is the period of one rep-rate plus the time to the end of the next gate, or as long as there is video present to maintain the signal. The start of printing is coincident with alarming. Output voltage is 0 to -8 volts. Output impedance is 1K ohms. Signal output is also available to drive low power relays or solenoids. This output is present as long as the alarm light is energized. Output is half wave, 60 cps at 8.8 volts peak. Output impedance is less than 50 ohms. See operation sections for Type S Recording Amplifier and Type R Relay Chassis.

c. SYNC CONTROLS

(1) MAIN PULSE (pointer)

With the control in this position, the start of the gate is synchronized by the initial pulse or "main bang". The gate start is initiated by a trigger pulse that is coincident with, or slightly ahead of the leading edge of the initial pulse or "main bang".

(2) FIRST ECHO (pointer)

In this position, the system is synchronized by the first echo signal to appear - presumably the interface or entrant signal. When employing immersed testing techniques, this permits setting the gate to include only the material under test while ignoring signal variations caused by changing water path distance. Immediately after the "main bang", a delay is created during which no returning video can synchronize

the ECHO GATE and marker sweep circuits. This delay time (9 - 80 u sec) is adjustable by R504 (internal) on the INTERFACE SYNC board, and is factory set for 20 u sec. In some cases it may be necessary to adjust this delay beyond some fixed echo prior to interface.

(3) MARKER SHIFT (vernier)

When the sync switch is in the FIRST ECHO position and the marker control on the Time Control Unit is in the IF position, a second trace will always be present on the CRT. The markers will be on this trace and their horizontal position (relative to the video trace) can be varied without disturbing the marker calibrations (figure 9-2).

2. FAMILIARIZATION (Figure 8-1, 9-1 and 9-2)

a. SET-UP

- (1) Assemble a Search Unit, UM Reflectoscope with Special Function Cabinet, and a test specimen.
- (2) Check that the Transigate unit is in position and properly secured.
- (3) If a Type S Recording Amplifier or a Type R Relay Chassis is being used, check the OPERATION sections on these units for proper procedure.
- (4) Turn on the UM Reflectoscope and with GATE control on Transigate to ON obtain a video trace and marker trace similar to that shown in Figure 9-2.

NOTE

Always turn power off when plugging special function components in or taking them out.

b. FAMILIARIZATION - GENERAL

Manipulate the various controls on the Transigate and observe the effects they have on the UM Reflectoscope presentation.

c. FAMILIARIZATION - DETAIL

- (1) With a presentation on the UM Reflectoscope similar to that shown in Figure 9-2 move the pointer on the SYNC control from MAIN PULSE

to FIRST ECHO (switch on Time Control unit to I. F.) and observe the effect on the traces. Leave the pointer on FIRST ECHO position. The video and the marker trace are now being synchronized by the first echo (presumably the entrant signal).

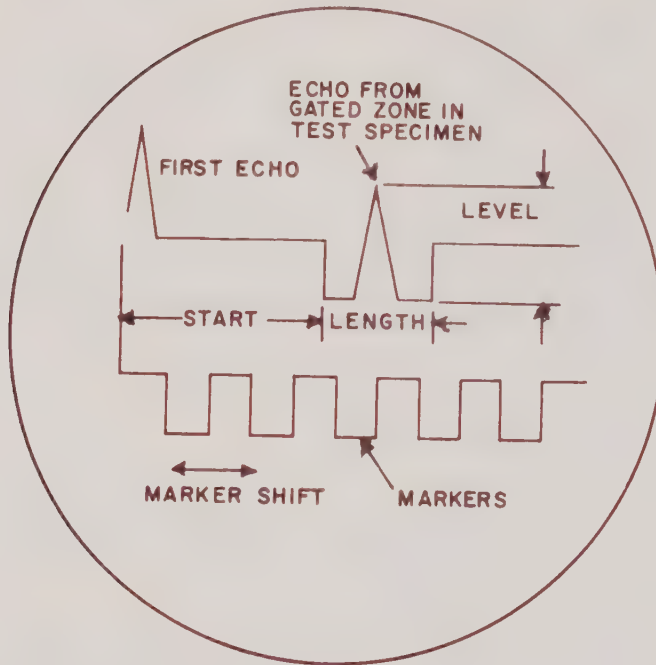


Figure 9-2
UM Reflectoscope Presentation with Transigate On

- (2) Go next to the GATE controls on the Transigate. Move the START pointer and observe that the gate image is moved across the screen in jumps, and that it will disappear to the right if the sweep circuits on the UM Reflectoscope are not readjusted. Next adjust the vernier on the START control and note that it will position the gate image continuously between the steps created by the pointer. Thus any "zone" in the test specimen after the first echo (from the entrant face) can be set up for examination.
- (3) Next adjust the pointer on the LENGTH control and observe that the width of the gate image (and therefore the width of the "zone" in the test specimen subjected to examination) changes in jump steps. Then adjust the vernier on the LENGTH control and observe that it will continuously adjust the gate image width between the steps created by the pointer.

- (4) By manipulating the GATE controls, SYNC controls, and the controls on the UM Reflectoscope, it should be possible to achieve a presentation similar to that shown in Figure 9-2.
- (5) With the MARKER control on the Time Control Unit in IF position, adjust the MARKER SHIFT vernier (on the SYNC control) and observe that the markers can be positioned relative to the video trace without changing the marker frequency (Figure 9-2).
- (6) Next manipulate the GAIN control on the Pulser Receiver to vary the amplitude of the echo in the gate and at the same time adjust the vernier LEVEL control on the Transigate and observe that the RESET light and buzzer (if the AUDIO switch is ON) can be activated at various predetermined levels of echo signal. Also move the pointer to + and - AUTO positions and note that in the + position the alarms are actuated when the echo signal exceeds the set level and that in the - position a decrease in signal achieves the same effect; also that the alarms reset automatically. The + and - MANUAL positions have the same effect except that the alarms have to be reset by pushing the RESET light.
- (7) If a Type S Recording Amplifier or a Type R Relay Chassis is being used, consult their operating instructions and observe that they react properly at the same time that the alarms are actuated.

d. TESTING

The gate should be set up according to the above using a test specimen (a "standard") similar to those for which continuous monitoring is desired. As the specimens are passed by the search unit all will be monitored in respect to the same zone and appropriate alarm or recording devices will be actuated in instances where deviations exist.

PRINCIPLES OF OPERATION

1. GENERAL

Figure 9-3 is a block diagram of the Transigate unit. The ECHO GATE receives a trigger from the Time Control Unit coincident with the main pulse or from the INTERFACE SYNC board coincident with the first echo depending upon the position of the SYNC control on the front panel. This trigger actuates

the gate multivibrators which produce a square wave (start and width controlled by START and LENGTH controls on front panel). This wave produces the gate image on the CRT and at the same time gates the video amplifier on the ECHO GATE which permits any video (echo pulses) which may be present from the specimen coincident with the gate to be passed to the RECORDER board.

The RECORDER board accepts the gated video and produces a DC level proportional to the amplitude of the largest signal in the gate. This DC is sent out via the R or S chassis to drive penmotor type recorders. It is also used to trigger a binary circuit (under control of the LEVEL adjustment) in the RECORDER - the on-off signal so produced is used to drive ALFAX type recorders and is also sent to the ALARM board to actuate the audio and visual alarm circuitry.

The ALARM board accepts the alarm signals from the RECORDER board (through front panel controls) and functions as an "automatic reset" oneshot or a "manual" flip-flop and drives the internal light and buzzer alarms.

The INTERFACE SYNC board accepts video from the UM Reflectoscope and after a delay which blanks out the "main bang" permits the first echo (from entrant face) to generate a trigger which is sent to the ECHO GATE to synchronize the gating circuitry. The marker shift circuits also generate a trigger which is used (if the Time Control MARKER control is in IF position) to synchronize the marker generator in the Time Control so that the markers can be moved in respect to the video trace.

The front and rear panel assembly contains the various external controls and the jacks and connectors for interconnecting the Transigate and for providing output alarm and print signals.

In the following detailed discussion of the circuitry, reference should be made to the overall schematic of the Transigate unit.

2. ECHO GATE 50C384

The Sync #2 square wave generated by the timer in the UM Reflectoscope is connected to pin 4, J201 via pin 13, J101 and is differentiated and clamped at

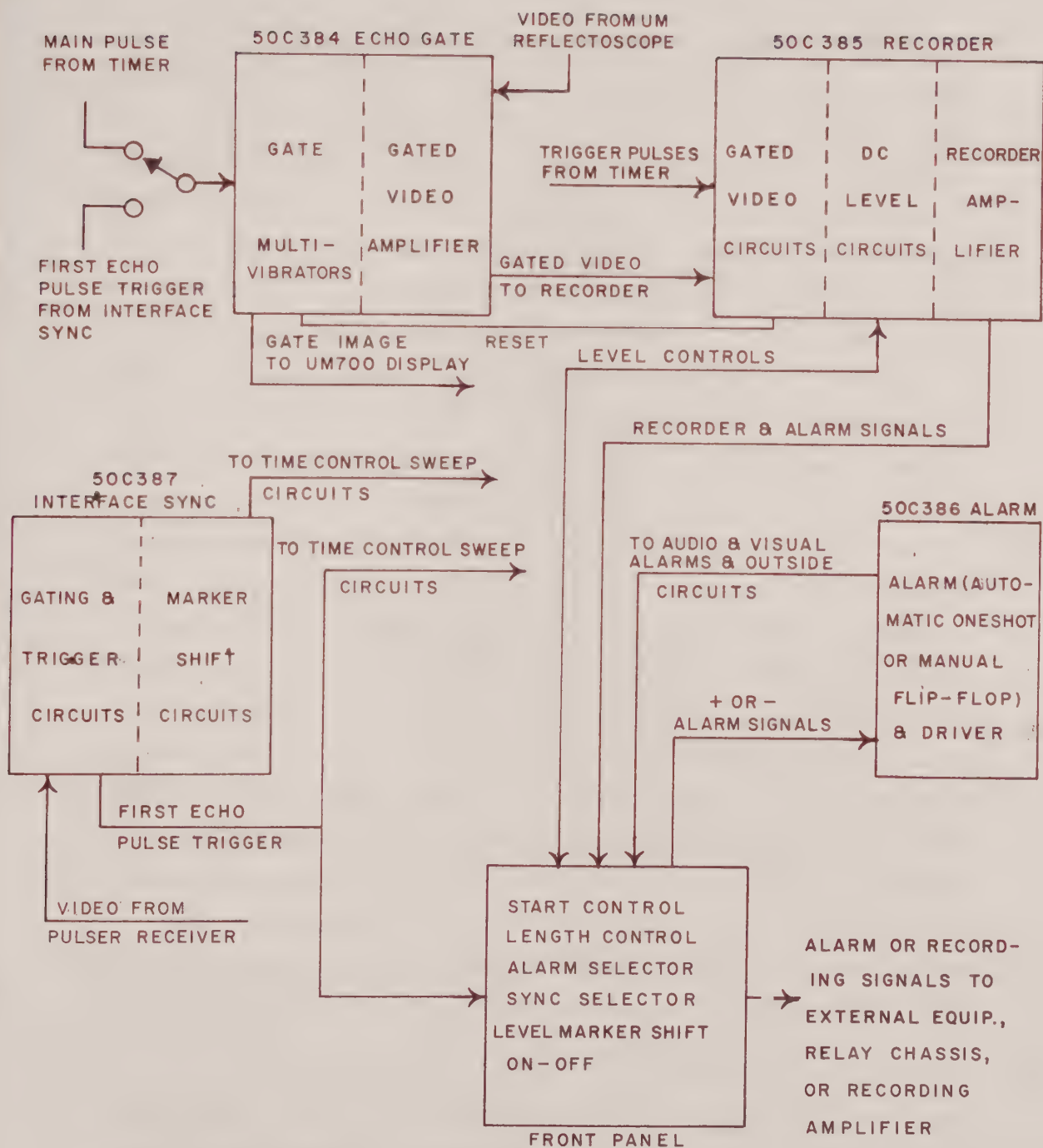


Figure 9-3
Block Diagram of Transigate Unit

C201, R201 and CR201. Q201 affords a low impedance trigger source for following circuits. When the front panel SYNC switch is set at MAIN PULSE, this trigger source is connected to pin 6, J201.

Q205 and Q206 comprise a monostable or oneshot multivibrator. The positive trigger pulse is amplified and inverted regeneratively by Q205. The resulting negative trigger couples the charge across C105, C106, C107 or C108 (depending on switch position). CR205 prevents excess current from flowing in the base of Q206. CR205 disconnects the emitter base junction of Q206 from timing circuit to aid temperature stability. The output square pulse is differentiated and clamped through C206, R218, and CR206 and coupled through C207 into the "length oneshot" monostable multivibrator, Q207, Q208, and Q209. Q208 provides a low impedance driving source for the timing network and gating circuit while at the same time preventing, by virtue of its relatively high input impedance, the waveform at collector Q207 from being degraded. The positive going square pulse is used to display the gate image on the cathode ray tube via pin 12, J201. CR207 becomes a part of a diode "or" gate when more than one ECHO GATE board is used. CR209 and CR208 perform the same functions as CR205 and CR204 above. The emitter of Q208 also drives a two transistor "and" gate consisting of Q204 and Q202. These transistors are in series. Q202 can only amplify and invert the video coming from pin 19, J201 when Q204 is conducting fully. Q204 is conducting fully only when the gate is being generated. CR202 sets the proper voltage level on the incoming video to match the input of Q202. This provides DC coupling to maintain good linearity of gated video regardless of signal level conditions. R208 is the range control and adjusts the amplitude of the pedestal voltage that occurs during the gate period. This pedestal voltage sets the proper operating level for the following circuitry. R206 adjusts the gain of the gated amplifier Q202.

3. RECORDER BOARD 50C385

Gated video from the ECHO GATE board enters at pin 8, J301. Q301 provides power gain to charge C301 through CR301 to near the video peak value. The gated video through Q301 is negative going and changes the voltage level at pin 4 of V301 from a quiescent 12 volts to the negative going peak value of the incoming gated video. The reverse slope of the video is disconnected from C301

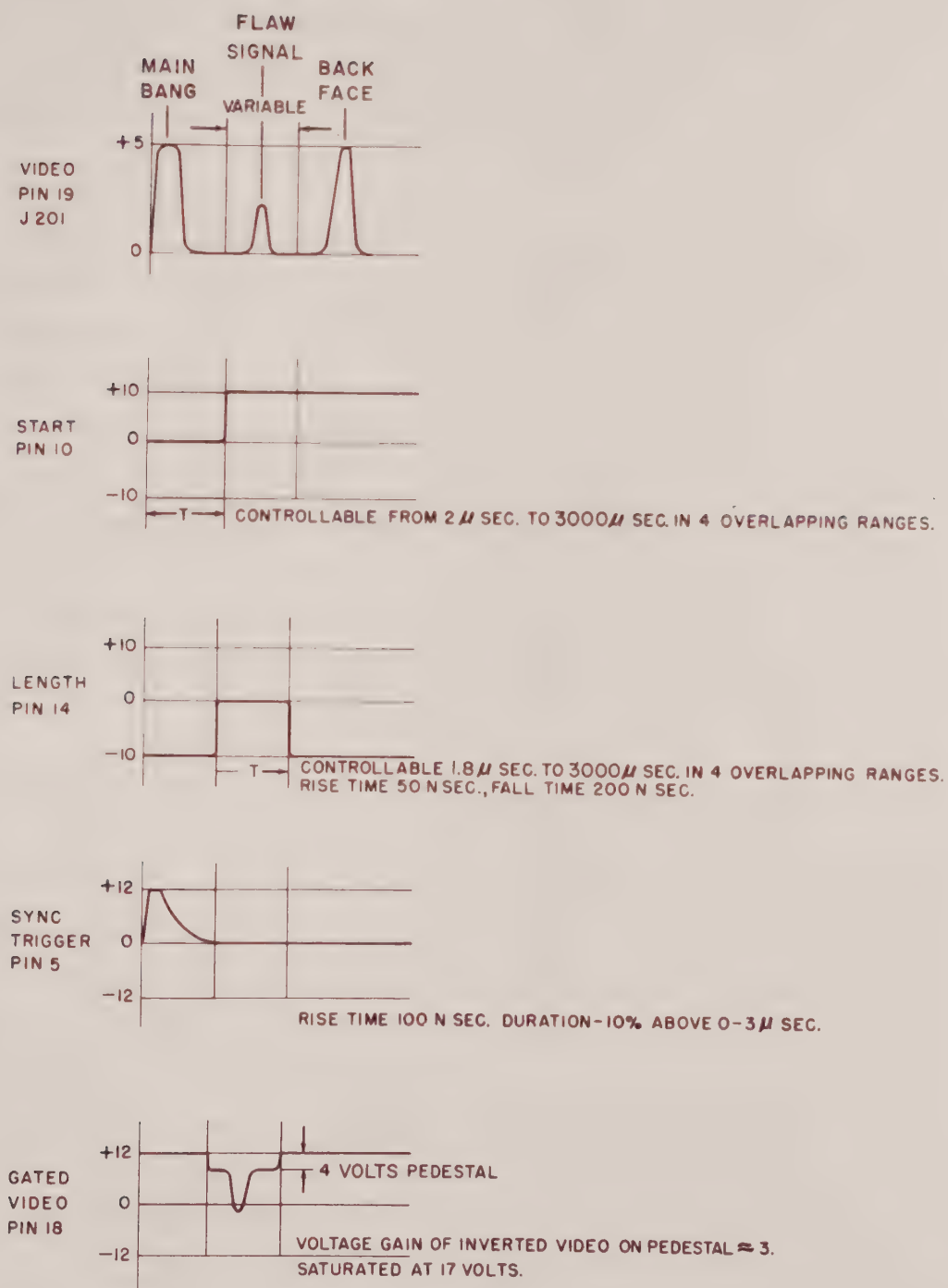


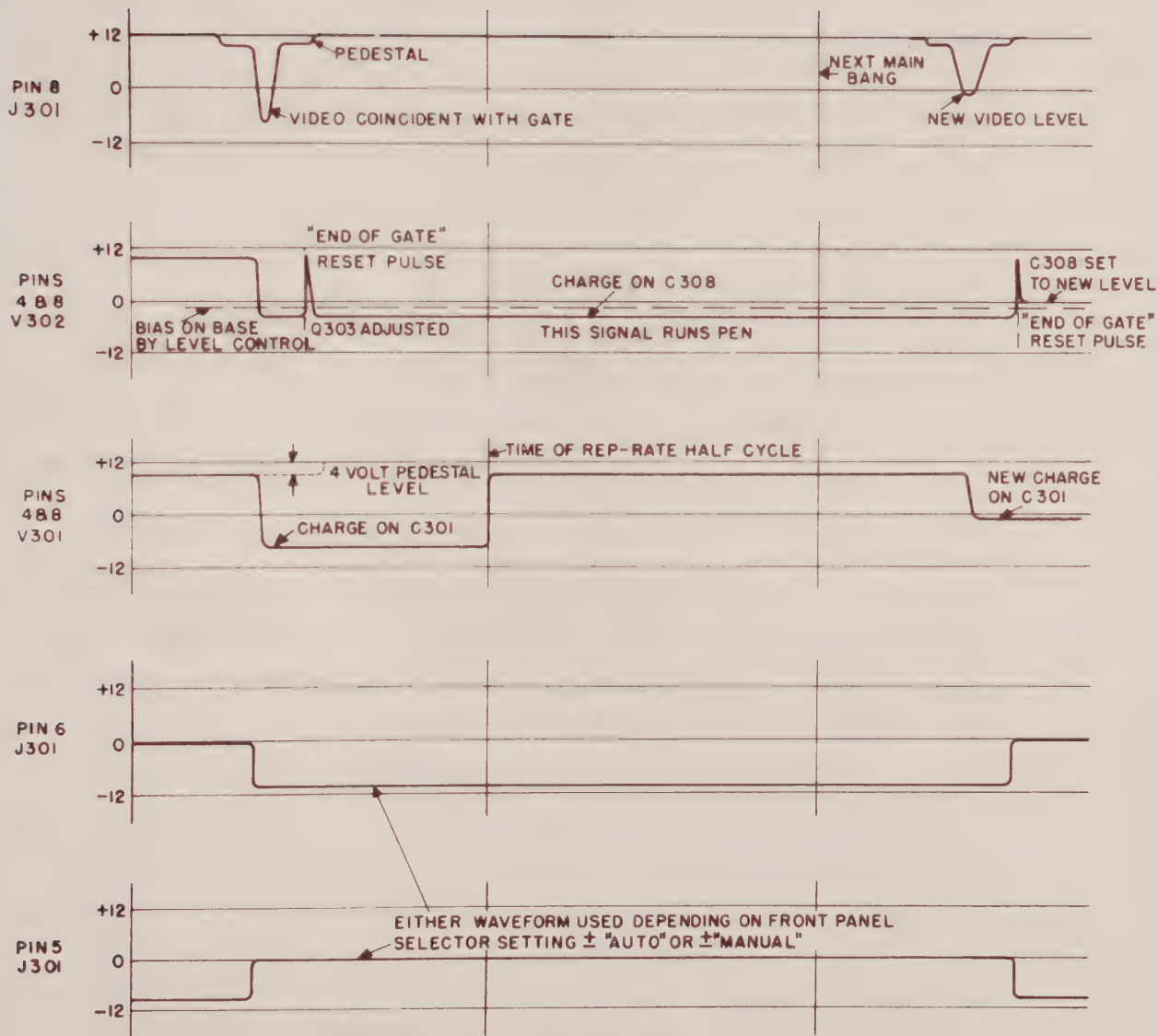
Figure 9-4
Echo Gate Waveforms

by diode CR301. This leaves the peak voltage charge on C301 which is also present at pin 4, V301. By cathode follower, (V301) this new voltage level is transferred to pin 8, V301. There is also the same quiescent 12 volt level at pin 4, V302. The new level at pin 8, V301 is now transferred to pin 4, V302 through CR303 diode. C308 is now at this new level. This all occurs during the first half cycle of the timer sync wave form.

At the half cycle interval of the sync wave form, a trigger pulse is derived from pin 10, J301. Q306 affords power gain to drive reset amplifier Q302. The short pulse, positive going, recharges C301 back to its initial -12 volt quiescent level via CR302. This level is again transferred to pin 8, V301. This time, however, CR303 is reverse biased and allows the original charge to be kept on C308. This capacitor now remembers the peak value of the last gated video pulse because of the very long time constant involved. The next main bang now occurs. If the new gated video coming from pin 8, J301 is greater in amplitude than the charge on C308, then both C301 and C308 will reach this new level. If the new level coming from pin 8 is of a lower amplitude, then only C301 is charged to its new level without affecting C308.

At the end of the gate a reset trigger pulse is derived from pin 19, J301, and is shaped and fed to reset amplifier Q307. The positive going pulse at the collector of Q307 connects CR304 and recharges C308 to +12 volt level but, because this is a short pulse, CR304 quickly disconnects while CR303 immediately connects and puts the "new peak" video level on C308. Thus the voltage level at pin 8, V302 varies in step intervals with its level proportional and approximately equal to the peak value of the gated video. If the gated video level is constant, the voltage level at pin 8, V302 is constant. If only one video pulse should enter, then a square pulse proportional to the height of the video pulse and equal to the time between the gated video and the end of the next gate will be presented.

CR102 on the LEVEL control maintains a constant DC level across R110 which varies the amount of reverse bias on Q303. Any signal in addition to this reverse bias must be great enough to make Q303 conduct. Proper rotation of the control will achieve this as will a changing voltage caused by incoming gated video at pin



WAVEFORMS ABOVE FOR ONE DISCRETE PULSE ABOVE "LEVEL"

Figure 9-5
Recorder Waveforms

8, J301. When Q303 does conduct, it affords power gain to make Q304, Q305 ("recorder amplifier") trip. Q304 and Q305 can only be in one of two conditions. When the collector of Q304 is at -10 volts, the collector of Q305 must be at ground potential and vice versa, so that when a gated video signal is great enough to overcome the controllable reverse bias on Q303, Q303 conducts making Q304-Q305 trip. As soon as the video disappears from the gate, they will go back to their original state.

By choosing the proper point (pin 6 or pin 5, J301), a negative signal is derived for either rising or falling gated video. This signal voltage will be present only when incoming gated video is greater than the setting of the LEVEL control bias.

4. INTERFACE OR FIRST ECHO SYNC 50C387

Q506 and Q507 form the major components of a transistor oneshot multivibrator. The collector of Q507 is normally near ground potential. This allows Q501 to act as an amplifier inverter for video signals incoming from pin 4, J501. Q501 is in this condition only between the end of delay of the "gate oneshot" and the advent of the next video pulse.

A concurrent trigger, positive going, from pin 5, J501 occurs during the "main bang" time and sets the "gate oneshot" Q506-Q507 into its quasi-stable state. The duration of this condition depends on the time constant of R504 times C501. While the oneshot is in its temporary state, the collector Q507 is at approximately -12 volts. This cuts off Q501 so that any incoming video will not be passed to Q502-Q503 binary. During the delay time being generated by Q506-Q507 "gate oneshot", flip-flop Q502-Q503 was set into one state by the same pulse that initiated the "gate oneshot".

After the delay has run its course in the "gate oneshot", Q501 is then turned on so that it may amplify incoming video. The first video pulse that enters after the delay is amplified in Q501 which in turn resets the "IF flip-flop" Q502-Q503. At the advent of this reset time, a pulse is sent through a shaper network and into trigger amplifier Q508 which in turn sends the pulse to the sweep generator. Any other video that may follow will no longer have any effect on the "IF flip-flop" so that no further trigger pulses to the sweep generator will come from this source

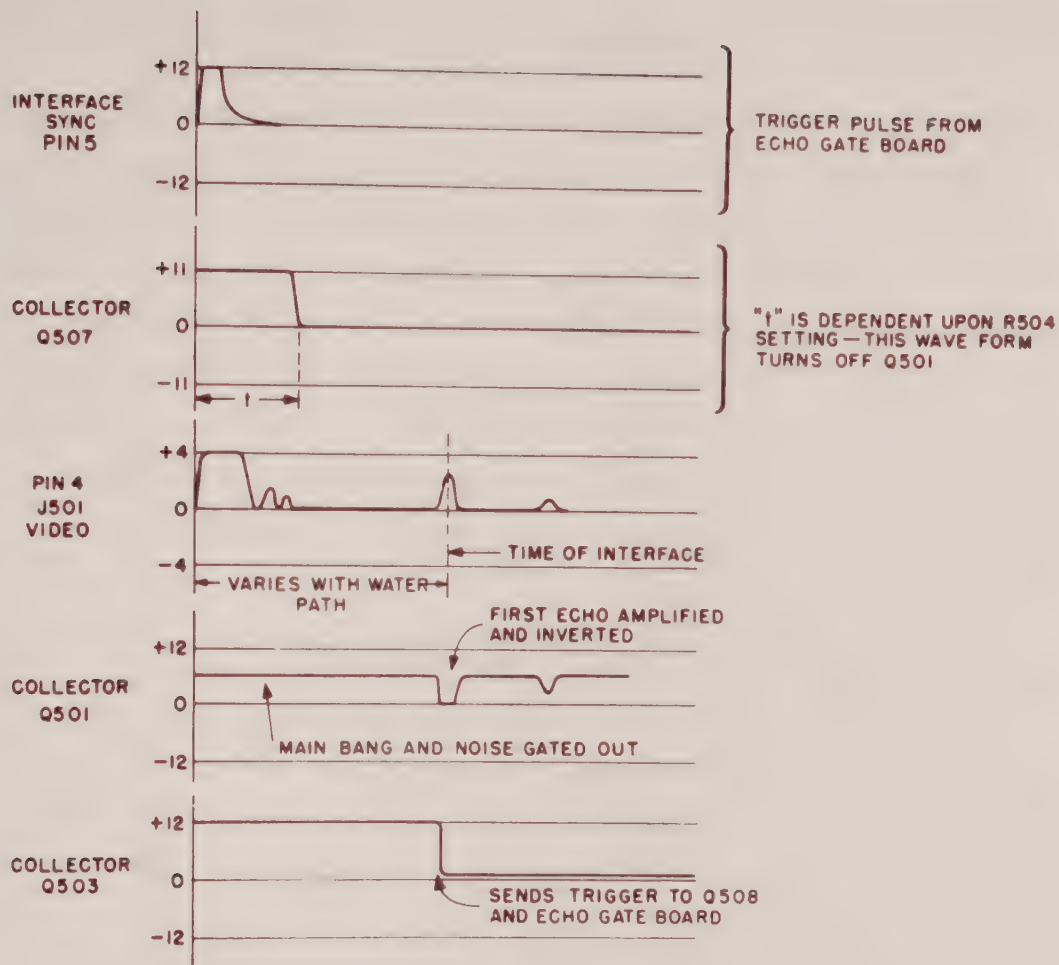


Figure 9-6
Interface Sync Waveforms

until after the next "main bang" and delay. The start of the sweep will be coincident with the first echo after the "main bang" which presumably is an interface signal.

Another monostable multivibrator (Q504-Q505) presents a delay time and trigger to Q508. This triggers the sweep generator during the next half cycle of the sync waveform coming from the timer. At that time the beam has been repositioned and the markers gated on, but no sweep is generated until C505 and R111, R109 and R113 (front panel MARKER SHIFT control) has been satisfied. This positions the markers in relation to the video sweep without changing the marker frequency. When the Timer controls and Transigate controls have been set properly for first echo sync and the "repetition rate", "sweep generator" and "marker shift" control settings do not conflict, the marker sweep will always be present on the CRT.

5. ALARM BOARD 50C386

When S103 (ALARM switch on front panel) is in either plus (+) or minus(-) AUTO position, Q401-Q402 are connected as a transistor oneshot multivibrator with a quasi-stable duration of approximately 152 milliseconds. With S103 in AUTO position and no video in the gate on the CRT above the LEVEL control setting, there will be a negative 10 volts present at pin 7, J401. If this is a short negative pulse (one single video pip in a long time) CR404 will connect this short pulse (which is always at least one rep-rate cycle long) to the one-shot which in turn will generate a 152 millisecond output through Q403 "EF driver".

If the video in the gate is continual, CR404 will remain connected because there is a continuous negative signal at pin 7, J401. Even though the oneshot time constants have run down, the multivibrator will not reset as long as pin 7 is negative.

When S103 is in $\pm$ MANUAL RESET position, Q401-Q402 becomes a flip-flop whose "armed" or "set" condition is Q401 "off", Q402 "on". When pin 7 turns negative CR404 connects and turns Q401 "on" and Q402 "off". This condition will remain regardless of what happens at pin 7; this is a continuous condition and can only be reset by closing S105 contacts manually.

The output from the ALARM board turns on transistor Q1 on the rear panel which actuates lamp DS103 and the buzzer if the AUDIO SWITCH, S106, is on. A signal is also present at pin 4, J401, for external purposes.

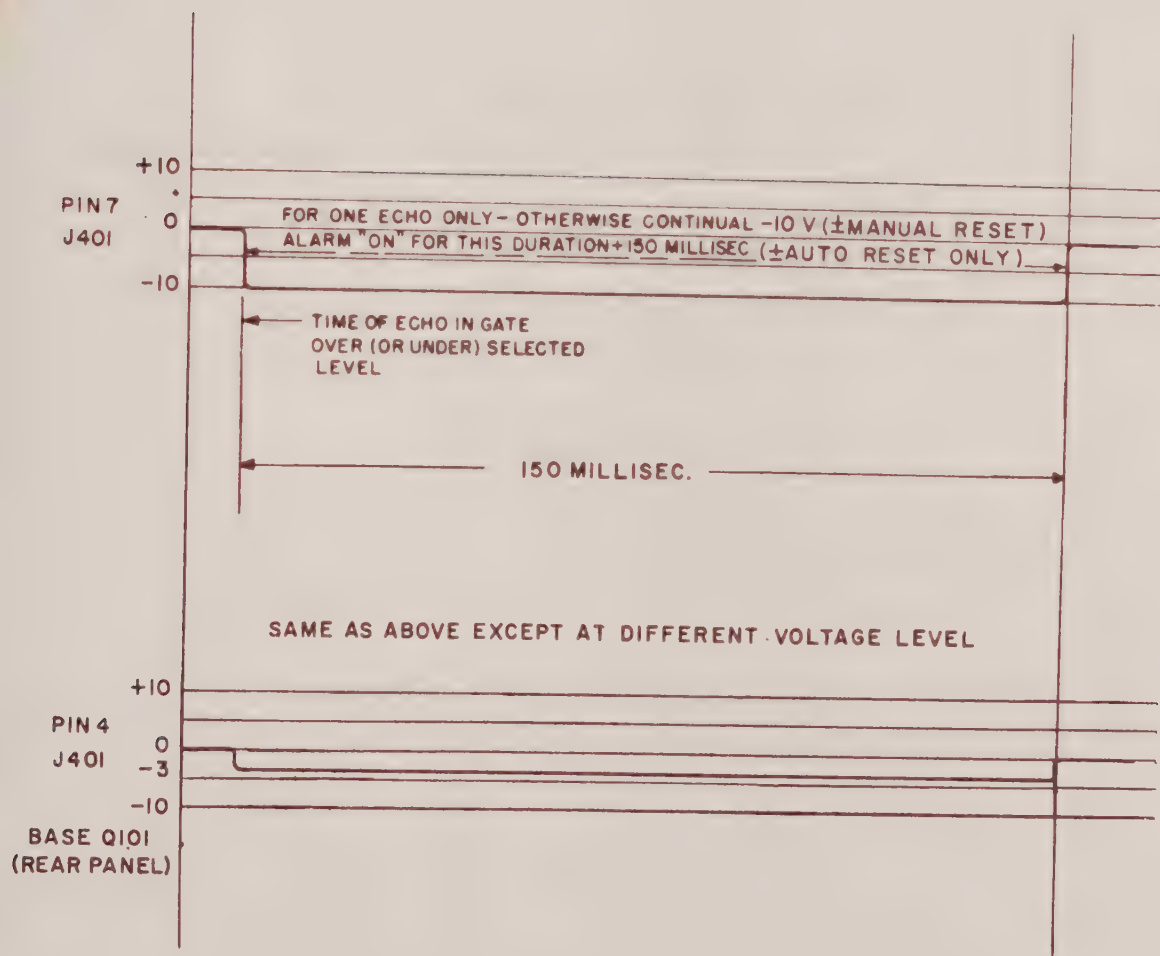


Figure 9-7
Alarm Board Waveforms

MAINTENANCE

WARNING

NEVER CONNECT OR DISCONNECT
TRANSISTORIZED PLUG-IN UNITS
OR P. C. BOARDS WHEN UM
REFLECTOSCOPE IS "ON".

1. GENERAL

a. TEST AND ASSOCIATED EQUIPMENT

The following test and associated equipment is required for checking the Transigate:

- (1) Servistension style 50C495.
- (2) Tektronix 531 or equivalent, recently calibrated.
- (3) Simpson Model 260, recently calibrated.

PERSONAL SAFETY WARNING

Lethal voltages are present - always turn instrument OFF when changing components. Always keep one hand in clear when making temporary connections (connecting test leads, etc.).

2. TRANSIGATE 50E550 CHASSIS INSPECTION AND MEASUREMENT

- a. Inspect chassis for loose or broken connections, loose components, signs of overheating etc.
- b. Rotate all front panel controls full counter-clockwise.
- c. Turn AUDIO switch off.
- d. Turn GATE switch off.
- e. Use Servistension and turn Transigate unit on. At printed circuit board connectors measure voltages below using Simpson 260 or equivalent.

CHART 1

TRANSIGATE VOLTAGE MEASUREMENTS

1	+11.8 vdc	1	+11.8 vdc	1	1	+11.8 vdc	1	+11.8 vdc
2	-11.8 vdc	2	-11.8 vdc	2	2	-11.8 vdc	2	-11.8 vdc
3	0	3	0	3	3	0	3	0
4	+5.4 v	4	+144 v	4	4	-.2 v	4	-11.6 v
5	.2 v	5	0	5	5	+3.7 v	5	
6	-10 v	6	-10 v	6	6	+.6 v	6	0
7	+128 v	7	+11.8 v	7	7	0	7	-2.2 v
8		8	+1. v	8	8	+3.7 v	8	+11.8 v
9	0	9		9	9		9	
10		10		10	10	+12	10	+144 v
11		11		11	11		11	+150 v
12		12	-11.8 v	12	12		12	
13		13	-11.8 v	13	13		13	
14		14	0	14	14		14	0
15		15	-1.1 v	15	15		15	0
16		16		16	16		16	+10.7 v
17	-104 vdc	17	-104 vdc	17	17		17	-104 v
18	0	18	+11.8 v	18	18		18	-1.8 v
19	+1.1 v	19	+5 v	19	19		19	-11.8 v
20	0	20		20	20		20	
J501		J201		J401		J301		
IF		Echo		Record		Alarm		
Board		Gate						

(VIEW OF CONNECTORS FROM BOTTOM)

TRANSIGATE UNIT

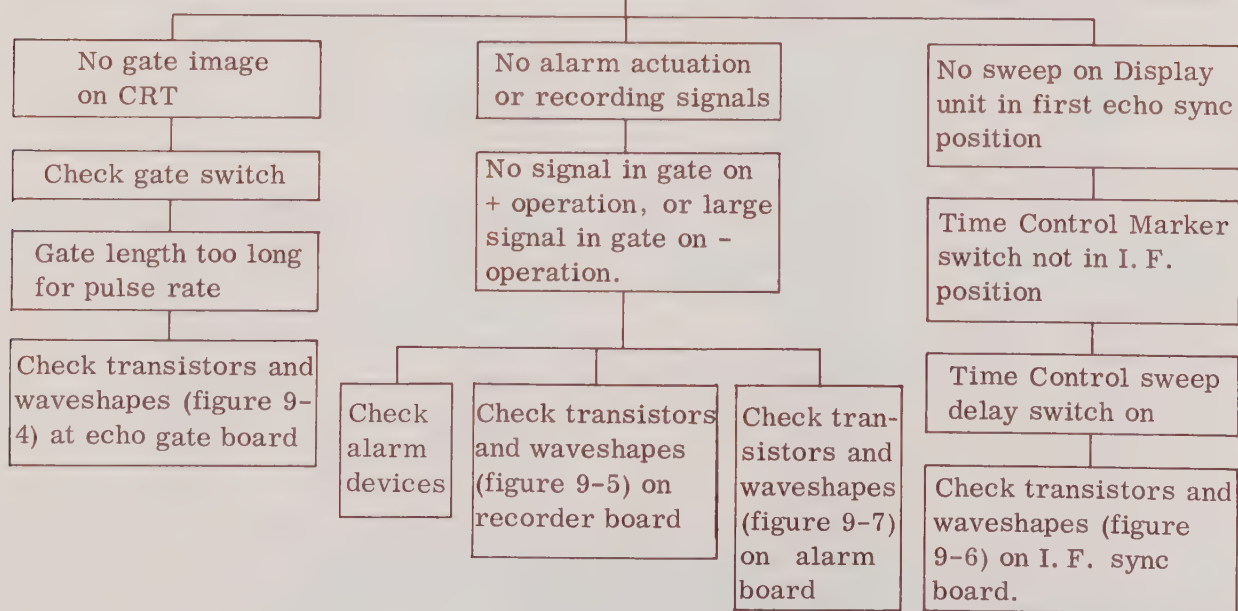
<u>CONTROL</u>	<u>SETTINGS</u>	<u>CONTROL</u>	<u>SETTINGS</u>
SYNC	MAIN PULSE OR	AUDIO SWITCH	ON
	FIRST ECHO	GATE SWITCH	ON
MARKER SHIFT	MID RANGE	START POINTER	1
ALARM		START VERNIER	MID RANGE
LEVEL	MID RANGE	LENGTH POINTER	1
SELECTOR	+ AUTO	LENGTH VERNIER	MID RANGE

TRANSIGATE UNIT IRREGULAR OR INOPERATIVE

Check that unit is properly in place, UM Reflectoscope is operating properly, cables are connected and firmly seated, controls on Transigate are properly set.

Remove Transigate and visually inspect for loose or missing transistors, poor connections on wires or components, burned components, or other obvious trouble.

Check voltage according to Chart 1



PARTS LIST

TRANSIGATE UNIT - STYLE 50E550
Reference Schematic 50E529

Schematic Symbol	Part No.	Description
C101	Paper	Capacitor .1 uf 200V
C102	Electrolytic	Capacitor 250 uf 25V
C103	DQLO01A22	Capacitor 250 uf
C104	Same as C101	
C105	1DP-3-154 Arco Elec.	Capacitor .15 uf 100 vdc
C106	1DP-1-253 Arco Elec.	Capacitor .025 uf 100 vdc
C107	DM-20-392 Arco Elec.	Capacitor 3900 uuf 500 vdc
C108	DQB009B21	Capacitor 560 uuf
C109	1DP-2-104 Arco Elec.	Capacitor .1 uf 100 vdc
C110	4DP-1-153 Arco Elec.	Capacitor .015 uf 400 vdc
C111	6DP-1-252 Arco Elec.	Capacitor .0025 uf 600 vdc
C112	Commercial	Capacitor 470 Pf 500 vdc 5%
C113	DA-104 Centralab	Capacitor .1 uf
C114	Same as C113	
C115	5GA-020 Sprague	Capacitor .002 mf 1KV
CR101	1N2525	Diode
CR102	1N1315A	Diode
CR103	1N90	Diode
CR104	1N914	Diode
CR105	Same as CR104	
DS101	Line Electric	Buzzer Series MD 6 vac
DS102	NE2	Lamp Neon
DS103	330	Lamp
J101	26-4100-24-P (334) Cinch	Plug
J201	Elco	Connector PCU420B
J301	Elco	Connector PCU420B
J401	Elco	Connector PCU420B
J501	Elco	Connector PCU420B
L101	4626 J. W. Miller	RF Choke
L102	Same as L101	
Q101	2N399	Transistor
R101	Commercial	Resistor 36K 1W 5%
R102	Commercial	Resistor 510K $\frac{1}{2}$ W 5%
R103	Part of 50B804	Potentiometer 500K
R104	Commercial	Resistor 39K 1W 5%
R105	Same as R102	
R106	Part of 50B804	Potentiometer 500K
R107	Commercial	Resistor 5.1K $\frac{1}{2}$ W 5%
R108	Commercial	Resistor 11K $\frac{1}{2}$ W 5%
R109	Part of 50B803	Potentiometer 0.5 Meg
R110	Part of 50B805	Potentiometer 10K

Schematic Symbol	Part No.	Description
R111	DPA004E10	Resistor 240K $\frac{1}{2}$ W
R112	Not used	
R113		
R114	Commercial	Resistor 330K $\frac{1}{2}$ W
R115	Commercial	Resistor 10 ohms $\frac{1}{2}$ W 5%
R116	Commercial	Resistor 10K $\frac{1}{2}$ W 5%
R117	Same as R116	
R118	Same as R116	
S101	Part of 50B804	Switch Rotary
S102	Part of 50B804	Switch Rotary
S103	Part of 50B805	Switch Rotary
S104	Part of 50B803	Switch Rotary
S105	50A2557	Switchlite
S106	SS-26-1 Stackpole	Switch Slide SPST
S107		Switch Slide DPST

50C384 ECHO GATE P. C. BOARD

C201	Commercial	Capacitor 500 uuf 300V
C202	5C7 Sprague	Capacitor .1 uf 25 vdc
C203	Commercial	Capacitor 330 uuf 500V
C204	Commercial	Capacitor 300 uuf 300V
C205	Same as C204	
C206	Commercial	Capacitor 470 uuf 300V
C207	BP861 Erie	Capacitor .001 uf
C208	Same as C201	
C209	DD300 Centralab	Capacitor 68 uuf 1000 vdc
CR201	1N482	Diode
CR202	VR6	Zener Diode
CR203	1N90	Diode
CR204	Same as CR201	
CR205	HB3 Hoffman	Diode
CR206	Same as CR203	
CR207	HB3 Hoffman	Diode
CR208	1N914	Diode
CR209	HB3 Hoffman	Diode
CR210	Same as CR203	
Q201	2N585	Transistor
Q202	Same as Q201	
Q203	2N404	Transistor
Q204	Same as Q201	
Q205	2N385	Transistor
Q206	Same as Q205	
Q207	2N309	Transistor
Q208	Not used	
Q209	2N404	Transistor

Schematic Symbol	Part No.	Description
R201	Commercial	Resistor 15K $\frac{1}{2}$ W 5%
R202	Commercial	Resistor 2K $\frac{1}{2}$ W 5%
R203	Commercial	Resistor 47K $\frac{1}{2}$ W 5%
R204	Commercial	Resistor 690 ohms $\frac{1}{2}$ W 5%
R205	Commercial	Resistor 3K $\frac{1}{2}$ W 5%
R206	275-1-202 Bourns	Potentiometer 2K
R207	Commercial	Resistor 1.5K $\frac{1}{2}$ W 5%
R208	276-1-503 Bourns	Potentiometer 50K
R209	Commercial	Resistor 27K $\frac{1}{2}$ W 5%
R210	Commercial	Resistor 51K $\frac{1}{2}$ W 5%
R211	Not used	
R212	Commercial	Resistor 10K $\frac{1}{2}$ W 5%
R213	Commercial	Resistor 30K $\frac{1}{2}$ W 5%
R214	Commercial	Resistor 5.1K $\frac{1}{2}$ W 5%
R215	Commercial	Resistor 680 ohms 1W 5%
R216	Commercial	Resistor 27K $\frac{1}{2}$ W 5%
R217	Same as R204	
R218	Same as R210	
R219	Same as R214	
R220	DPA004C07	Resistor 1.8K $\frac{1}{2}$ W 5%
R221	Same as R204	
R222	Same as R215	

50C385 RECORDER P.C. BOARD

C301	60P-1-102 Arco	Capacitor .001 uf 600 vdc
C302	Commercial	Capacitor 300 uuf 500V
C303	Not used	
C304	Commercial	Capacitor 180 uuf 500V
C305		
C306	ED-510 Erie	Capacitor 510 uuf
C307	Not used	
C308	6DP-1-402 Arco	Capacitor .004 uf 600 vdc
CR301	1N485	Diode
CR302	Same as CR301	
CR303	Same as CR301	
CR304	Same as CR301	
R301	Commercial	Resistor 270 ohms $\frac{1}{2}$ W 5%
R302	Commercial	Resistor 5.6K 2W
R303	Commercial	Resistor 11K $\frac{1}{2}$ W 5%
R304	Commercial	Resistor 15K $\frac{1}{2}$ W 5%
R305	Commercial	Resistor 510 ohms $\frac{1}{2}$ W 5%
R306	Commercial	Resistor 9.1K $\frac{1}{2}$ W 5%
R307	Same as R305	
R308	Commercial	Resistor 10K $\frac{1}{2}$ W 5%
R309	Commercial	Resistor 56K $\frac{1}{2}$ W 5%
R310	Commercial	Resistor 24K $\frac{1}{2}$ W 5%

Schematic
Symbol

Part No.

Description

R311	Commercial	Resistor 910 ohms $\frac{1}{2}$ W 5%
R312	Commercial	Resistor 47K $\frac{1}{2}$ W 5%
R313	Same as R312	
R314	Same as R312	
R315	Commercial	Resistor 5.6K $\frac{1}{2}$ W 5%
R316	Same as R304	
R317	Commercial	Resistor 1.8K $\frac{1}{2}$ W 5%
R318	Commercial	Resistor 2K $\frac{1}{2}$ W 5%
R319	Commercial	Resistor 750K $\frac{1}{2}$ W 5%
R320	Same as R308	
R321	Not used	
R322	Commercial	Resistor 3.9K $\frac{1}{2}$ W 5%
R323	Not used	
R324	Commercial	Resistor 56K 1W 25%
R325	Same as R312	
R326	Same as R308	
R327	Commercial	Resistor 33K $\frac{1}{2}$ W 5%
Q301	2N404	Transistor
Q302	Same as Q301	
Q303	Same as Q301	
Q304	Same as Q301	
Q305	Same as Q301	
Q306	2N404A	Transistor
Q307	Same as Q301	
V301	6CW4	Tube
V302	Same as V301	
	Elco	Transistor Socket 3303
	Cinch-Jones	Tube Socket 133 65101001
	50B807	Recorder P.C. Board Sub-Assembly

50C386 ALARM P.C. BOARD

C401	TE1305 Sprague	Capacitor 20 uf 50 vdc
C402	Commercial	Capacitor 240 uuf 500V
C403	Same as C402	
C404	55023 Sprague	Capacitor .05 uf 50 vdc
CR401	1N90	Diode
CR402	Same as CR401	
CR403	Same as CR401	
CR404	Same as CR401	
R401	Commercial	Resistor 5.1K $\frac{1}{2}$ W 5%
R402	Commercial	Resistor 330 ohms $\frac{1}{2}$ W 5%
R403	Commercial	Resistor 2K $\frac{1}{2}$ W 5%
R404	Same as R401	
~~R405~~	Same as R403	

Schematic

Symbol

Part No.

Description

R406	Same as R403	
R407	Commercial	Resistor 510 ohms $\frac{1}{2}$ W 5%
R408	Same as R407	
R409	Same as R407	
R410	Commercial	Resistor 10K $\frac{1}{2}$ W 5%
R411	Same as R410	
R412	Commercial	Resistor 200 ohms $\frac{1}{2}$ W 5%
R413	Commercial	Resistor 150 ohms $\frac{1}{2}$ W 5%
Q401	2N404	Transistor
Q402	Same as Q401	
Q403	Same as Q401	

50C387 INTERFACE SYNC P.C. BOARD

C501	6DP-1-202 Arco	Capacitor .002 uf 600 vdc
C502	Style 15 M.M	Capacitor 160 uuf 500V
C503	DA203 Centralab	Capacitor .02 uf 30 vdc
C504	Not used	
C505	Not used	
C506	Style 15 M.M	Capacitor 300 uuf 300V
C507	Same as C506	
C508	Not used	
C509	Not used	
C510	ET8805 Erie	Capacitor .01 uf 100 vdc
C511	Style 15 M.M	Capacitor 330 uuf 300V
C512	Not used	
C513	Not used	
C514	Not used	
C515	Style 15 M.M	Capacitor 180 uuf 500V
CR501	1N90	Diode
CR502	Not used	
CR503	Not used	
CR504	Not used	
CR505	Same as CR501	
Q501	2N585	Transistor
Q502	2N404	Transistor
Q503	Same as Q502	
Q504	Not used	
Q505	Not used	
Q506	Same as Q501	
Q507	Same as Q501	
R501	Commercial	Resistor 3.3K $\frac{1}{2}$ W 5%
R502	Commercial	Resistor 1K $\frac{1}{2}$ W 5%
R503	Commercial	Resistor 5.1K $\frac{1}{2}$ W 5%
R504	276-1-503 Bourns	Potentiometer 50K
R505	Not used	

Schematic Symbol	Part No.	Description
R506	Commercial	Resistor 30K $\frac{1}{2}$ W 5%
R507	Commercial	Resistor 120 ohms $\frac{1}{2}$ W 5%
R508	Same as R506	
R509	Not used	
R510	Not used	
R511	Not used	
R512	Commercial	Resistor 12K $\frac{1}{2}$ W 5%
R513	Commercial	Resistor 1.8K $\frac{1}{2}$ W 5%
R514	Commercial	Resistor 15K $\frac{1}{2}$ W 5%
R515	Same as R514	
R516	Not used	
R517	Not used	
R518	Commercial	Resistor 51K $\frac{1}{2}$ W 5%
R519	Commercial	Resistor 120K $\frac{1}{2}$ W 5%
R520	Commercial	Resistor 4.3K $\frac{1}{2}$ W 5%
R521	Same as R503	
R522	Same as R513	

TIMER A SERIES

with - Gate Generator
IF Synchronization
Marker Generator
- options



AUTOMATION INDUSTRIES, INC. SPERRY DIVISION

SHELTER ROCK ROAD
DANBURY, CONNECTICUT 06810 U.S.A.
(203) 748-3581

Revised 7/73

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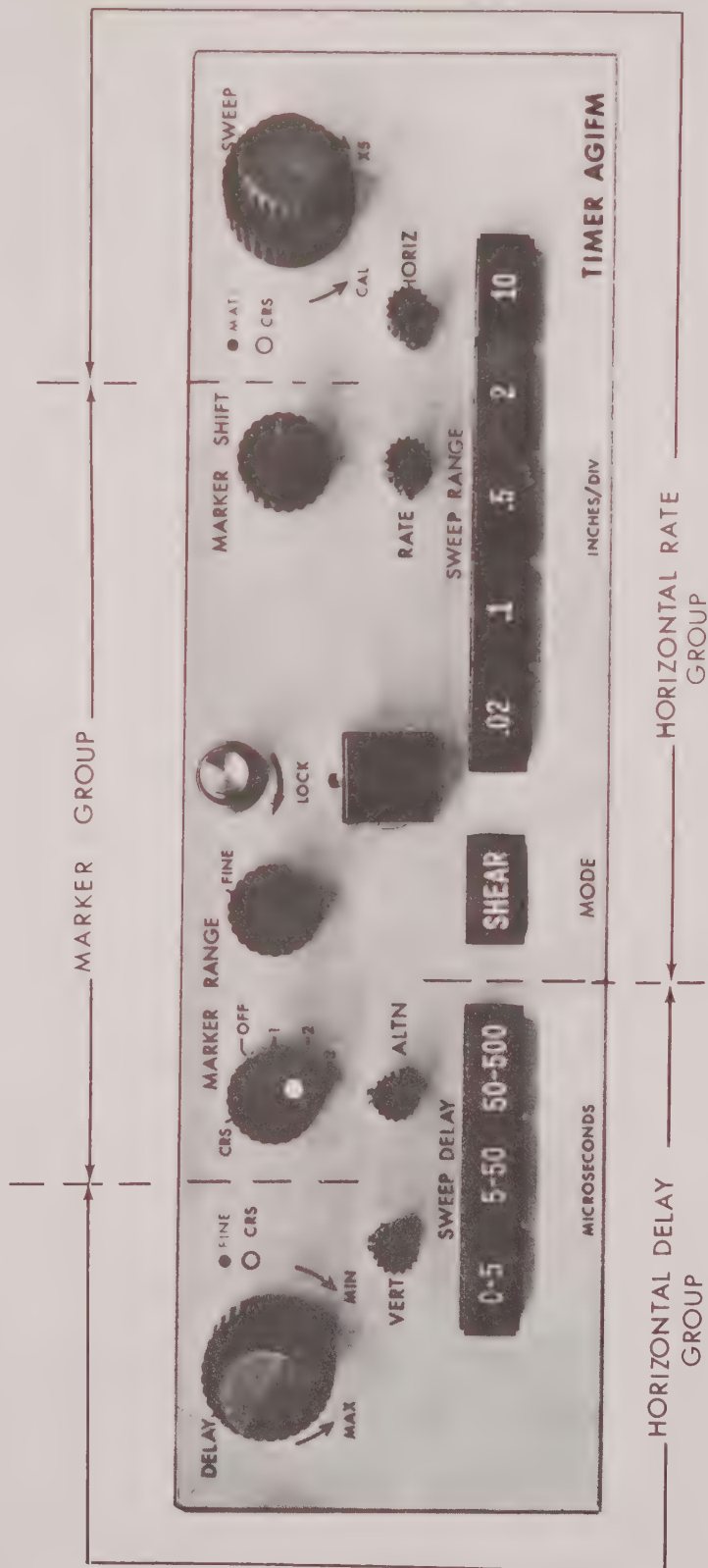


FIGURE 1 — FRONT PANEL CONTROLS



AUTOMATION INDUSTRIES, INC.

SECTION 1 - GENERAL

1.0 GENERAL

The Timer unit of a Reflectoscope provides variable horizontal time bases for the viewing CRT as well as synchronizing and gating signals for ultrasonic measuring and signal processing sub-units. More specifically, the Timer A Series of units is designed to generate the widest usable range of time related functions for the Automation Sperry UM771/775 instruments. Some of these functions are standard and some are options available for special applications.

1.1 SCOPE

This preliminary manual includes a general description of the Timer A Series measuring capabilities and control functions.

1.2 DESCRIPTION

Physically the Timer A (Series) is a slide-in, all solid-state board (approximately 7" w x 15"l), which mounts both discrete and integrated circuit components. It has an 8" wide x 2-3/8" high front panel.

Controls exist at three levels:

1. Front panel controls or operating/set-up controls.
2. Internal panel controls needing access only on the set-up of certain optional (markers, gating, alarm) capabilities.
3. PCB screwdriver controls requiring factory calibration-type adjustments.

The function of type 1 and 2 controls is given in Section 2 - Operation, of this preliminary operating manual.

Ultrasonic nondestructive detection, as accomplished by Reflectoscope methods, lends itself to four broad classes of materials analysis:

1. Flaw Detection - The detection and location of a wide variety of surface and internal defects. These include deficient weldments and laminar bonds, corrosion, pitting, inclusions, voids, porosity and similar discontinuities.

2. Physical Property - The determination of (or compensation for) differences in material properties insofar as they are related to ultrasonic propagation, velocity and attenuation (grain size, nodularity, dispersion homogeneity and elasticity).
3. Geometry - Measurement of such geometric parameters as thickness, tube wall variations, eccentricity, straightness, diameter, radius.
4. Process Control - In-line control through the combination of ultrasonic instrumentation and automated material handling equipment.

The basic Timer of the series is designated A. It has the capabilities of adjustable sweep delay and sweep length, mode switching for the calibration of longitudinal/shear wave velocities, material difference calibration and CRT trace position controls.

Options

1. Option "G" additionally generates a gate of variable length and position. This subsection also creates the possibility of an aural/visual "alarm-on-defect" signal and an analog output.
2. Option "IF" enables the stabilization of gate/interface/signal relationships when operating under immersion conditions.
3. Option "M" enables the generation of second trace square wave markers which can be varied in repetition rate, position and range.

The timer family thus becomes A, AG or AGIF, each with the separately available option of markers; i.e., AGIFM.

1.3

SPECIFICATIONS

1. Overall size: 8" x 2-3/8" x 18"
2. Weight: 2½ pounds
3. Sweep delay: 0 - 500 usecs
4. Sweep range: .02" - 10"/division
5. Rep rate (sweep trace)

6. Rep rate (markers)
7. Temperature: 20°F to 160°F
8. Range capabilities translate to 555" of steel.

SECTION 2 - OPERATION

2.0 GENERAL

The operation section will first describe the function of four groups of front panel controls and then proceed to the internal panel controls. All PCB screwdriver adjustments will be treated in a subsequent manual under theory and maintenance.

Front Panel Control Groups:

1. Horizontal delay controls give coarse, fine and stepped control over sweep delay. This enables working over a great range of material thickness.
2. The time or rate controls give coarse, fine and stepped control over the CRT sweep speed and thereby the relative expansion/contraction of the horizontal viewing time scale; i.e., horizontal signal magnification and/or calibration for different materials.
3. The marker group gives coarse, fine and stepped control over pulse repetition frequency of the square wave marker scale.

It is also possible to shift the markers independently as to horizontal position.

4. Vertical, alternate, horizontal and marker shift controls displace the CRT trace independently of any time related function.

2.1

Front Panel Controls:

1. DELAY (CRS) (R-102). Coarse control over the duration of sweep delay. (Delay enables the operator to center signals regardless of thickness of material.)
2. DELAY (FINE) (R-108). Vernier control over the duration of sweep delay. (MAX-MIN rotational directions are indicated on controls 1 and 2 above.)
3. SWEEP DELAY MICROSECONDS (S-202). Gives three step control over sweep delay from 0 - 500 microseconds.

4. SWEEP (CRS) (R-104). Controls the duration of the sweep pulse. (Sweep rate enables the horizontal expansion/contraction of displayed waveforms and calibration against the graticule system.)
5. SWEEP (MATL) (R-103). Varies horizontal calibration to compensate for propagation velocity of materials.
6. SWEEP RANGE INCHES/DIV (S-203). Gives five step control over sweep range from .02 - 10 inches/division.
7. MODE (SHEAR) (S-201). Compensates for difference between longitudinal and shear velocity in steel (only).
8. VERTICAL (R-106) and HORIZ (R-107). Displaces primary trace position. ALTN (R-105) displaces whatever alternate trace is used along the vertical axis.
9. RATE (R-101). Controls the basic pulse repetition rate of the timer circuitry. (100 - 2000Hz)
10. MARKER RANGE CRS (S-101). Turns marker function "on" and sets to three stepped ranges of marker repetition rates.
11. MARKER RANGE FINE (R-110). Fine adjustment of marker repetition rate.
12. MARKER SHIFT (R-109). Adjusts horizontal position of marker trace.

2.2 Internal Panel Controls (See Figure 2)

1. GATE START (FINE) (R-303). Varies time constant of gate start circuit (IC300) by varying R/C network resistance.
2. GATE START (CRS) (S-301). Varies time constant of gate start circuit (IC300) by large R/C capacitor steps.
3. GATE LENGTH (FINE) (R-305). Varies time constant of gate length circuit (IC301) by varying R/C network resistance.
4. GATE LENGTH (CRS) (S-302). Varies time constant of gate length circuit (IC301) large R/C capacitor steps.
5. IF SYNC (S-300). Enable/defeat IF sync function. A three position switch synchronizes time of start of gate and sweep to compensate for variations in length of water path in immersion testing.

IF SYNC-GATE SWP. Gate and sweep are started by first video signal (interface).

IF SYNC-GATE. Gate only is started by interface signal.

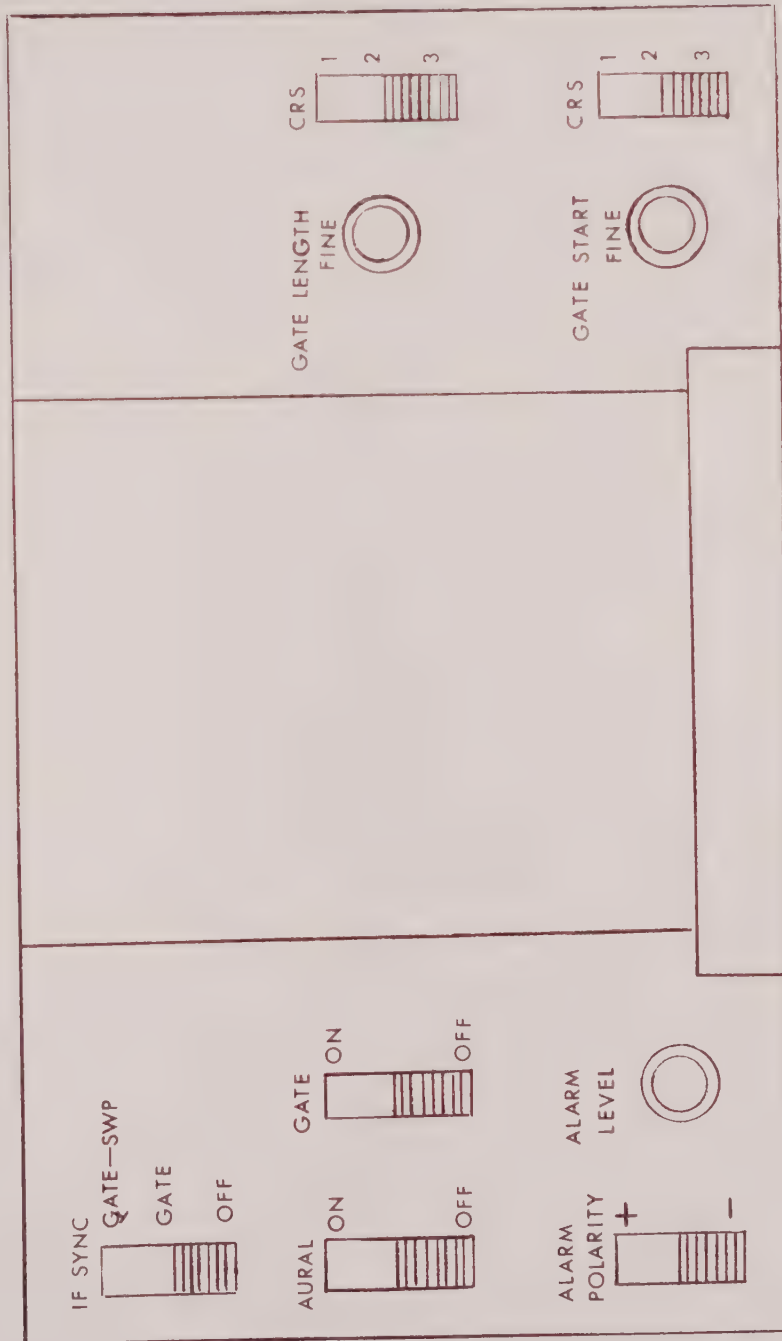


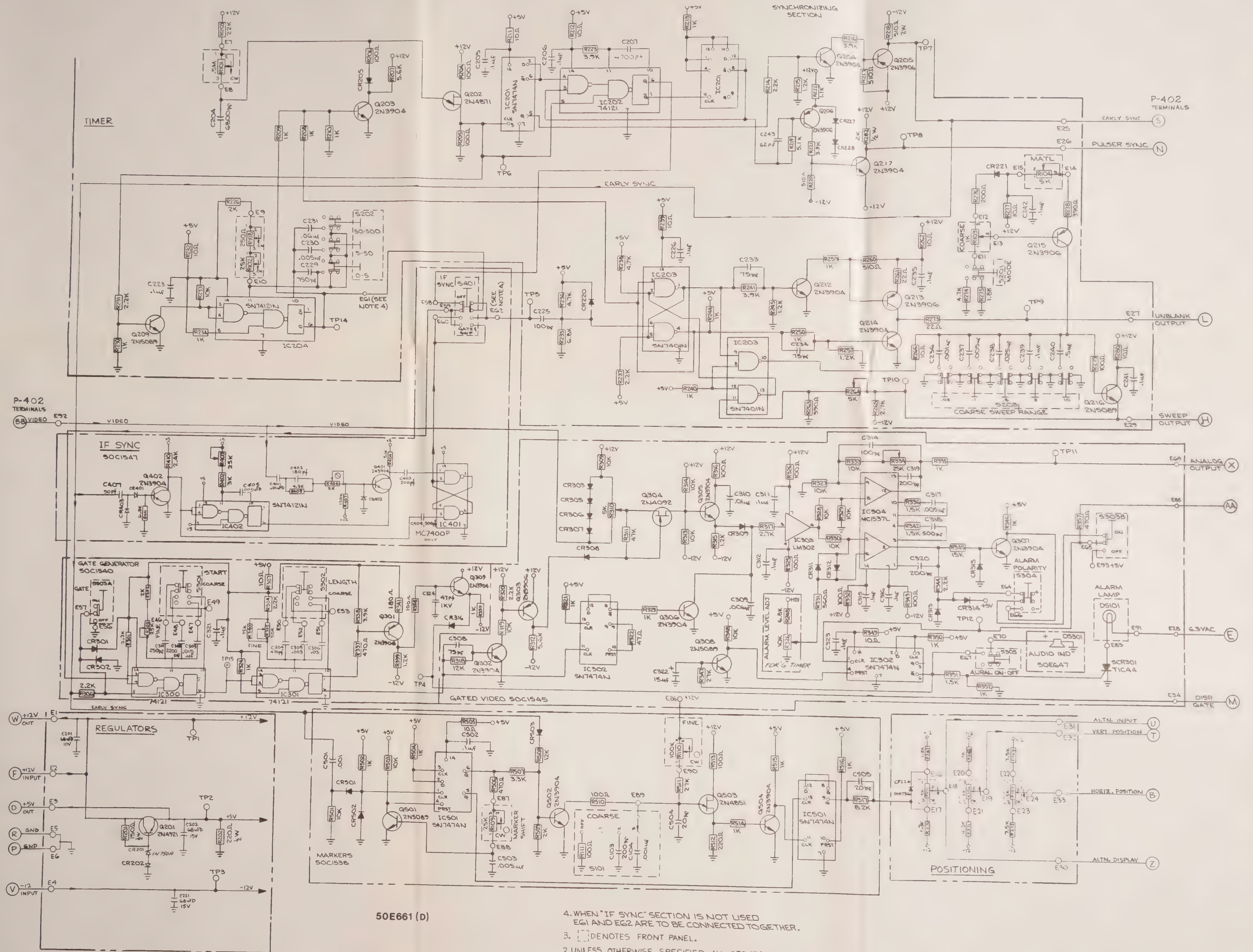
FIGURE 2 — INTERNAL PANEL CONTROLS

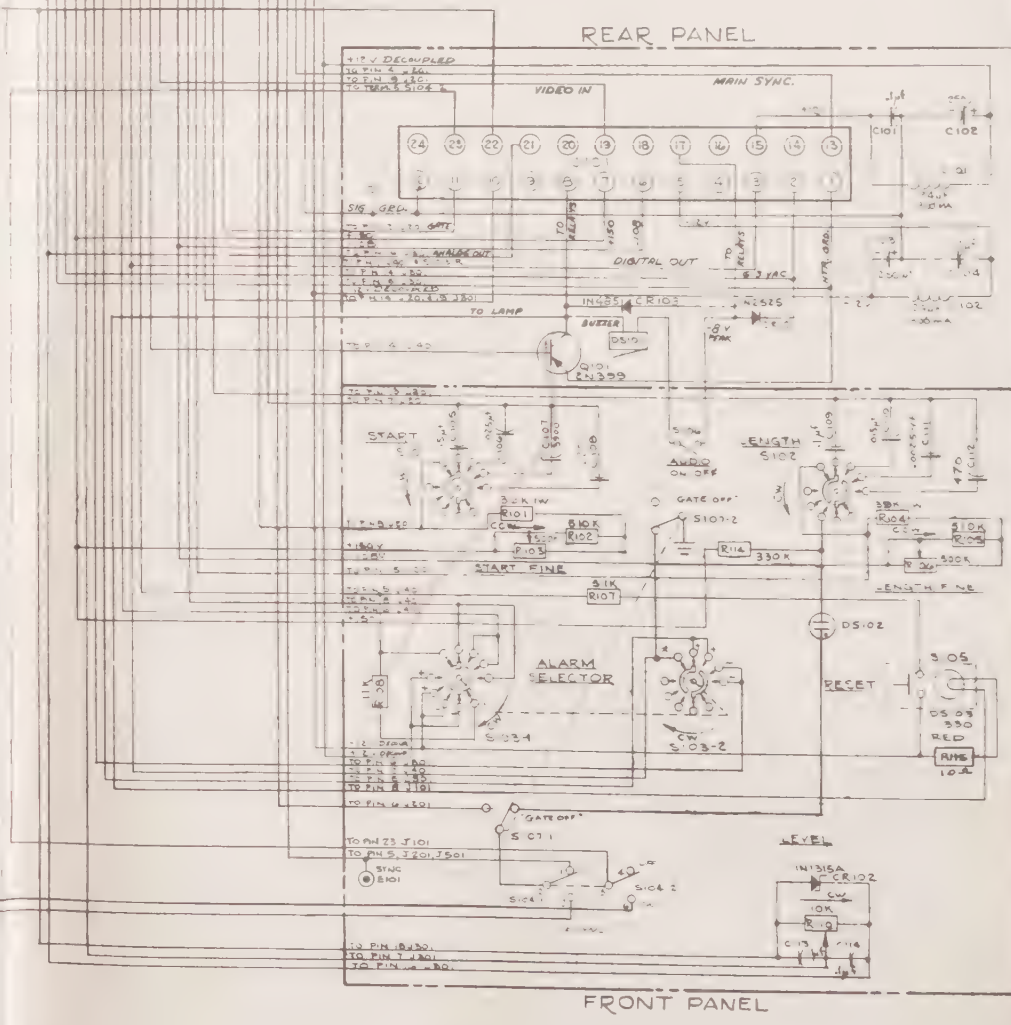
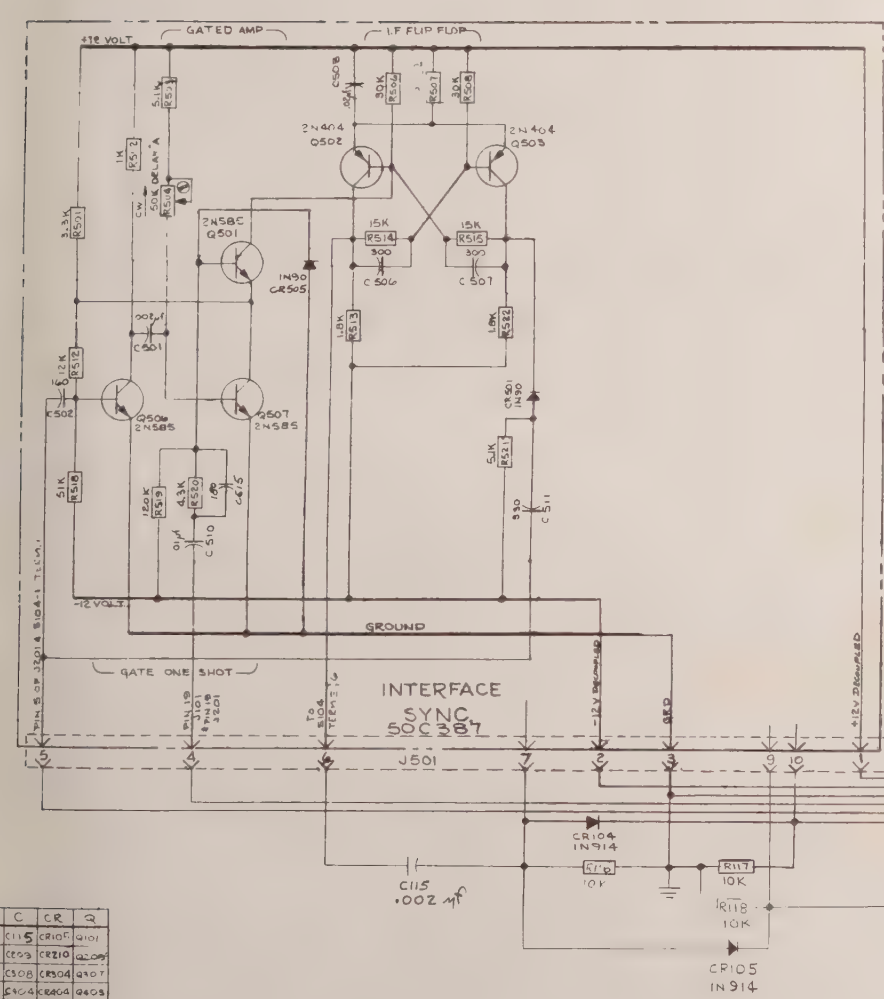
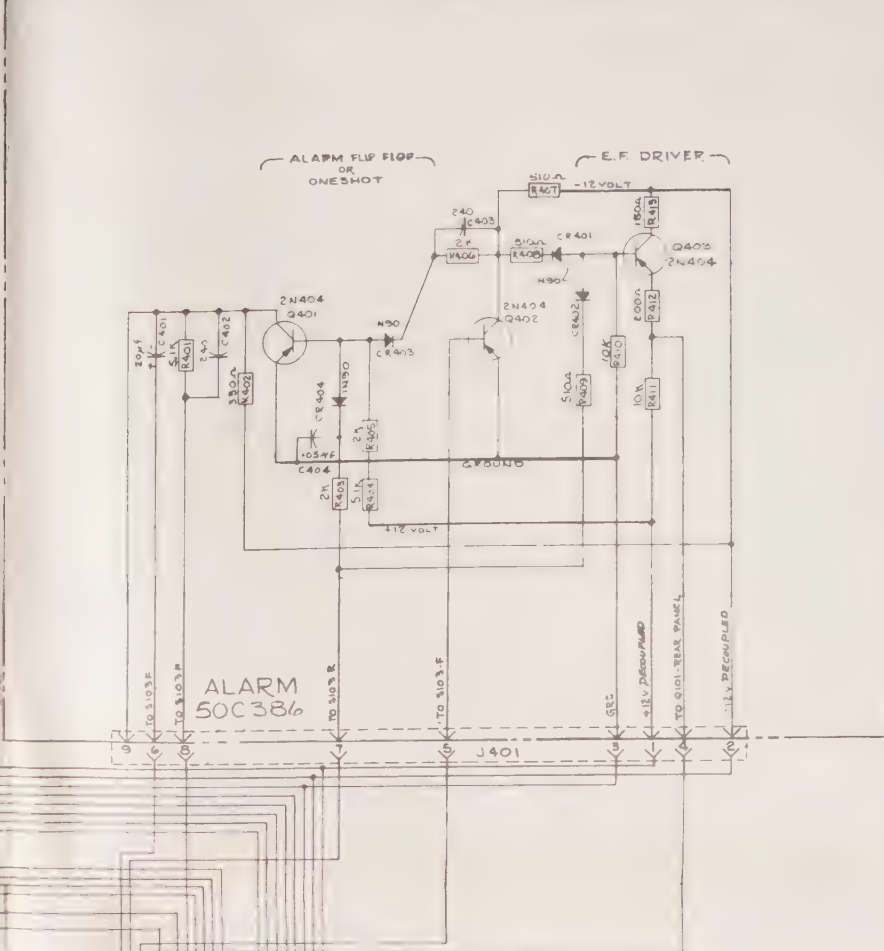
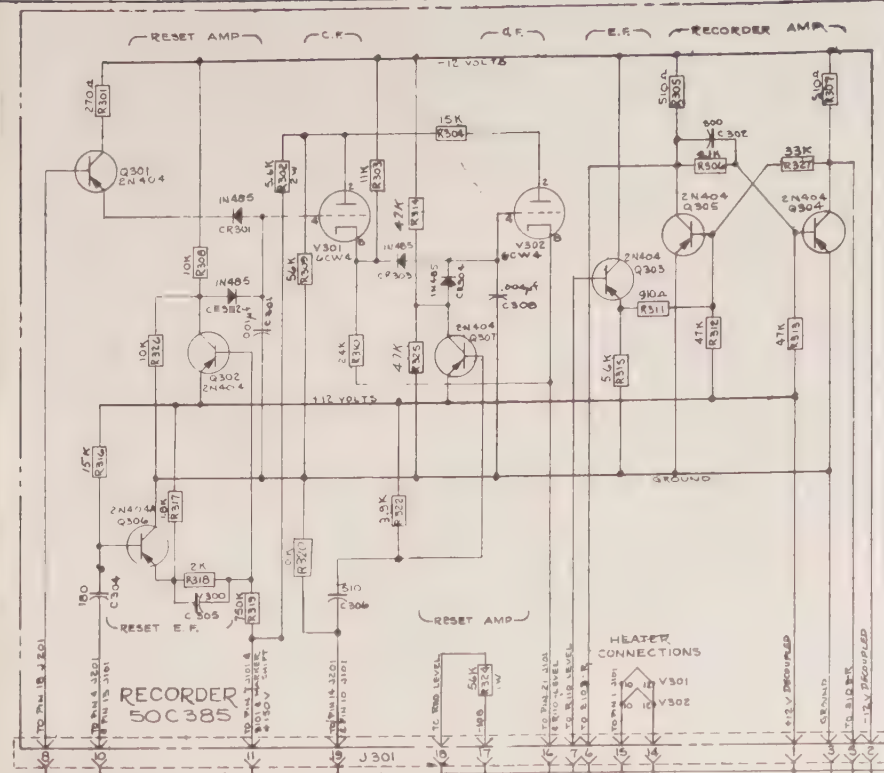
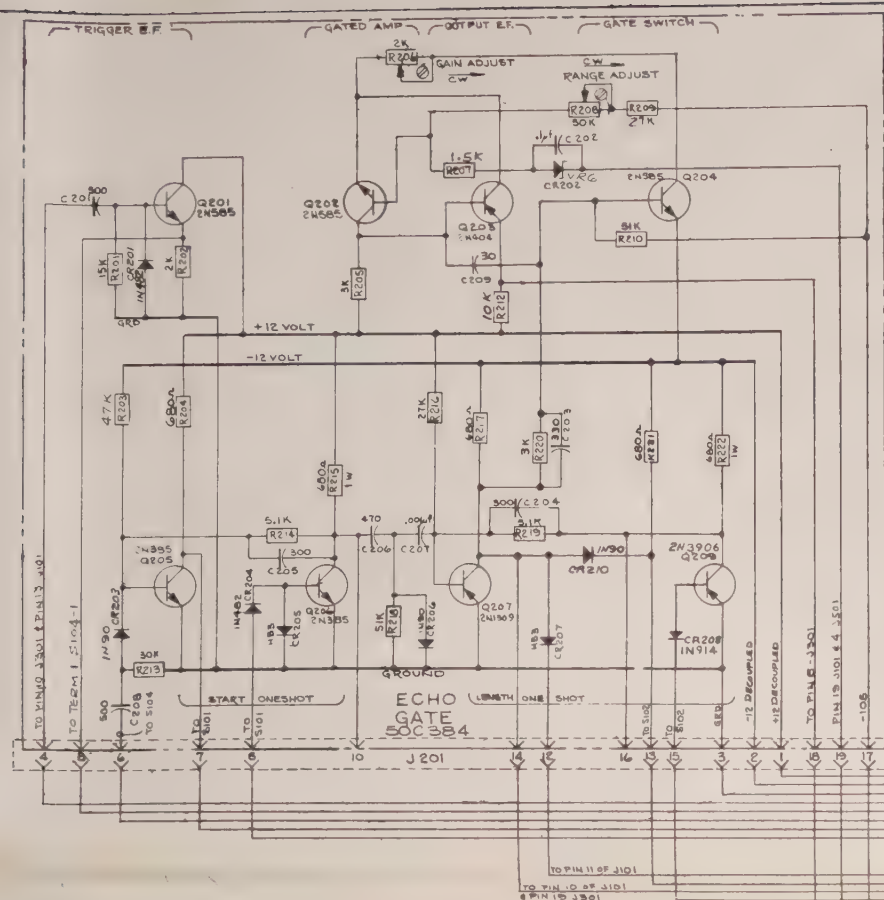
IF SYNC-OFF. Interface synchronization capability disabled.
Gate is started from "main sync" time and sweep is started
after sweep delay.

6. GATE ON-OFF (S-303). Enable/defeat gate function.
7. AURAL ON-OFF (S-305). Enable/defeat auditory alarm.
8. ALARM POLARITY $\pm$ (S-304). Alarm on + or - video signal.
9. ALARM LEVEL (R-326). Sets video level at which alarm
signal is activated.

SECTION 3 - DRAWINGS

Drawing 50E661 has been included for reference only in this preliminary issue of the instruction manual.





1/5/85
Note recorder output
is from J-103
pin #21 in Pulse/Resistor Chain

NOT USED	USED
R11	C115
R22	C201
R27	C202
R41	C203
R52	C204
R53	C205
R54	C206
R55	C207
R56	C208
R57	C209
R58	C210
R59	C211
R60	C212
R61	C213
R62	C214
R63	C215
R64	C216
R65	C217
R66	C218
R67	C219
R68	C220
R69	C221
R70	C222
R71	C223
R72	C224
R73	C225
R74	C226
R75	C227
R76	C228
R77	C229
R78	C230
R79	C231
R80	C232
R81	C233
R82	C234
R83	C235
R84	C236
R85	C237
R86	C238
R87	C239
R88	C240
R89	C241
R90	C242
R91	C243
R92	C244
R93	C245
R94	C246
R95	C247
R96	C248
R97	C249
R98	C250
R99	C251
R100	C252

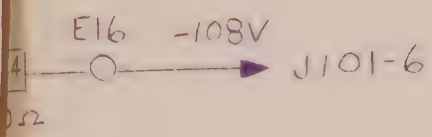
NOTE
EXCEPT AS NOTED
ALL RESISTORS ARE 1/2 WATT ± 5%
ALL CAPACITORS ARE µF
ALL SWITCHES VIEWED FROM REAR

50E529

SPERRY PRODUCTS COMPANY
50E529 AUTOMATIC IN-PROCESSING
SCHEMATIC
50E529

DATE: 1/5/85
BY: [Signature]
CHECKED BY: [Signature]

E



A

B

E



A

ITEM	QTY	CODE IDENT	PART NUMBER	DESCRIPTION
PARTS LIST				
SIGNATURES		DATE		AUTOMATION INDUSTRIES, INC. SPERRY DIVISON 
DRAWN <i>[Signature]</i>		1-13-72		
CHECKED <i>[Signature]</i>		2-20-72		
APPROVED <i>[Signature]</i>		2-20-72		
ENGINEER				
TITLE				
SCHEMATIC PULSER/RECEIVER 10W DAC				
APPROVED DESIGN ACTIVITY		SIZE	CODE IDENT NO.	DRAWING NO.
APPROVED		E	78446	50E623
SCALE				SHEET

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

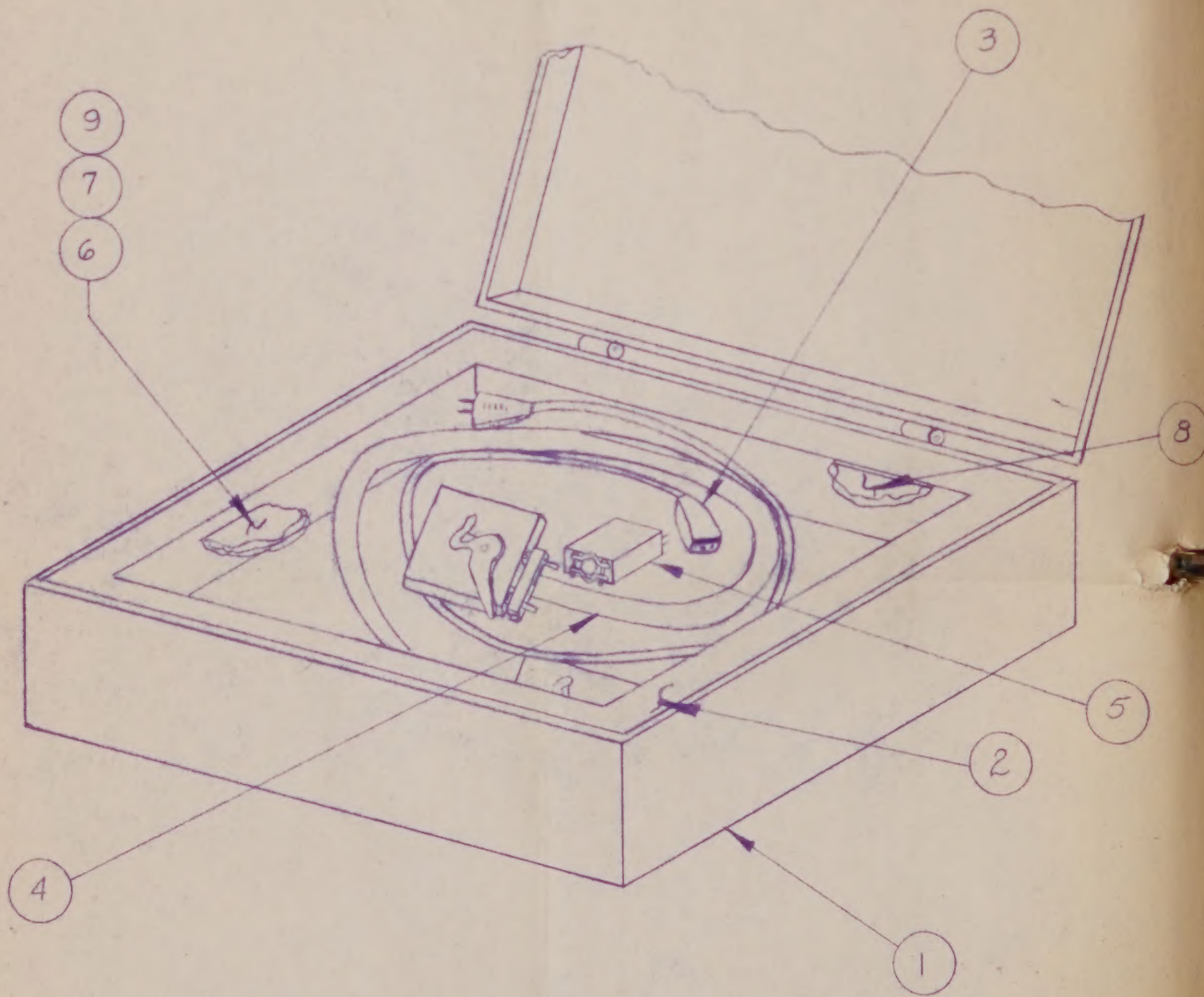
		ENVELOPE, MYLAR 22 x 4 1/4	
	50B1807	ACCESSORY KIT	
	3AG	FUSE 1/4A, 125V	LITTLEFUSE
	3AG	FUSE 1/4A, 125V	LITTLEFUSE
	P-312-CCT	PLUG	CINCH JONES
	50B1809	JUMPER CABLE	
	50A2594	POWER CORD	
	50B1646	FOAM INSERT	
	50B1649	BOX	
CODE IDENT	PART NUMBER	DESCRIPTION	MAT'L
			MAT'L SPEC

PARTS LIST

OTHERWISE SPECIFIED ARE IN INCHES UNLESS ON EC. ANGLES .005 ± 0°30'	SIGNATURES		DATE	AUTOMATION INDUSTRIES, INC. SPERRY DIVISION		
	DRAWN L. CONROY		7-23-70	TITLE		
	CHECKED MP		7-3-70	ACCESSORY KIT		
	APPROVED D S		7-3-70	RECORDING AMP. UNIT		
	ENGINEER					
	R		7-3-70			
APPROVED DESIGN ACTIVITY				SIZE	CODE IDENT NO.	DRAWING NO.
APPROVED				B	78446	50B1807
				SCALE		SHEET 1 OF 1

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ITEMS 6 & 7 TO BE PACKAGED
IN ENVELOPES ITEM 9.

50E617	50E617
50E616	50E616
NEXT ASSY	USED ON
APPLICATION	



PROPERTY OF U. S. GOVERNMENT

